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A RAND NOTE

Middle-Term Disaggregate Loss Model Test and Evaluation: Description and Results

Allan F. Abrahamse

July 1988

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40 Years 1948-1988
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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER N-2688-AF	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Middle-Term Disaggregate Loss Model Test and Evaluation: Description and Results		5. TYPE OF REPORT & PERIOD COVERED Interim
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Allan F. Abrahamse		8. CONTRACT OR GRANT NUMBER(s) F49620-86-C-0008
9. PERFORMING ORGANIZATION NAME AND ADDRESS The RAND Corporation 1700 Main Street Santa Monica, CA. 90406		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Directorate of Plans Office, DCS/Plans and Operations Hq, USAF, Washington, DC 20330		12. REPORT DATE July 1988
		13. NUMBER OF PAGES 91
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release: Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

No Restrictions

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Air Force Personnel	Mathematical Models
Reenlistment	Text and Evaluation
Attrition	Forecasting

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See reverse side

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UNCLASSIFIED

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This Note describes the testing and evaluation of a set of equations developed for use in the Air Force's Enlisted Force Management System. The equations predict annual airman loss and reenlistment rates by Air Force Specialty Code. Predictions from the loss models are compared to actual loss rates and to loss rates estimated by the model currently being used by the Air Force.

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Middle–Term Disaggregate Loss Model Test and Evaluation: Description and Results

Allan F. Abrahamse

July 1988

Prepared for
The United States Air Force

40 Years 1948-1988

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PREFACE

This Note describes the testing and evaluation of a set of equations that predict airman loss and reenlistment behavior. The equations were developed for use in the Air Force's Enlisted Force Management System (EFMS). The conceptual design of the EFMS includes a variety of loss models distinguished by the time horizon of their predictions (short-, middle-, or long-term) and whether such predictions are disaggregated by occupational specialty.

This document concerns the middle-term disaggregate loss model, which predicts annual loss rates by Air Force Specialty Code (AFSC). Its predictions are designed to be most accurate between one and four years into the future. For an overview of the EFMS, see Grace M. Carter, Jan M. Chaiken, Michael P. Murray, and Warren E. Walker, *Conceptual Design of an Enlisted Force Management System for the Air Force*, The RAND Corporation, N-2005-AF, August 1983.

The test and evaluation results in this Note do not indicate how the models will perform in the operational EFMS. The models tested here are those documented in Grace Carter, Michael Murray, R. Yılmaz Argüden, Marygail Brauner, Harvey Greenberg, Deborah Skoller, *Middle-Term Loss Prediction Models for the Air Force Enlisted Management System: Specification and Estimation*, The RAND Corporation, R-3482-AF, December 1987. The operational models will differ in parameter values, structure, and performance, partly because of changes in specification that resulted from the outcome of the test and evaluation process. It is also partly because the models will be updated with more recent data before their use in the EFMS. Subsequent test and evaluation results for the revised models will appear in future documents.

This Note should be useful to three classes of readers:

1. Persons interested in the performance of the set of middle-term disaggregate loss models that existed in May 1986.
2. Analysts charged with improving those models.
3. Persons responsible for evaluating future versions of the models.

Although the Note contains a few technical sections, most of it is simple and straightforward and an extensive statistical background is not required.

The work described here is part of the Enlisted Force Management Project (EFMP), a joint effort of the Air Force (through the Deputy Chief of Staff for Personnel) and The RAND Corporation. RAND's work falls within the Resource Management Program of Project AIR FORCE. The EFMP is part of a larger body of work in that program concerned with the effective utilization of human resources in the Air Force.

SUMMARY

Air Force planners use *inventory projection models (IPMs)* to predict how an initial inventory of airmen will look in the future. Such IPMs contain *loss models* that estimate how many members of the initial inventory leave the service during the period in question. *Middle-term disaggregate loss models* predict annual loss rates, by Air Force Specialty Code (AFSC) and certain other factors.

In 1983, as part of a larger effort to develop a new Enlisted Force Management System (EFMS) for the Air Force (Carter et al., 1983), RAND began developing a set of middle-term disaggregate loss models for use in the EFMS's Middle-Term Disaggregate IPM. This document describes the testing and evaluation (T&E) of these loss models. **The purpose of the T&E exercise was to identify problems with the models so that the problems could be fixed before the models were implemented in the EFMS.**

The T&E showed that the loss models as they stood in May of 1986 were good enough to be encouraging, but not good enough to be satisfying. In general, they performed at least as well as the disaggregate loss models used in ALPS. But the exercise identified a number of specific problems, some of which have been corrected already, some of which are in the process of being corrected, and some of which will receive attention in the future. By the time the EFMS becomes operational, the models evaluated here will have been modified and updated. Their performance will differ from that shown here.

ACKNOWLEDGMENTS

The test and evaluation process described in this Note is but one of the steps in a long and arduous trail that has included database construction and model development. Many members of the Enlisted Force Management Project (EFMP), both at RAND and in the Air Force, have been involved in these tasks.

Among those who contributed to the construction of the databases used for fitting the original models and used in this test and evaluation were RAND colleagues Grace Carter, Michael Murray, Leola Cutler, and Darlene Blake. Air Force colleagues Lieutenant Colonel Robert Barnhardt and Captain Rory Quesinberry helped obtain the Airman Loss Probability System (ALPS) data that were used for comparison with the EFMS models. RAND colleague Robert Young put these data in a form that enabled them to be used in the comparison.

The EFMS models were specified and estimated by Michael Murray, Grace Carter, Marygail Brauner, Yılmaz Argüden, Deborah Skoller, and Major Harvey Greenberg.

Warren Walker, EFMP project leader, did much of the editorial work necessary to unify this material. James Hodges read a draft and provided several suggestions to improve the clarity and readability of the text.

CONTENTS

FIGURES

TABLES

GLOSSARY

AFSC	Air Force Specialty Code
ALPS	Airman Loss Probability System
CFG	Career Field Group
EFMS	Enlisted Force Management System
ETS	Expiration of Term of Service
FY	Fiscal Year
IPM	Inventory Projection Model
PE	Prediction Error
PEPNR	Prediction Error as Percent of Number at Risk
PRE	Percent Relative Error
SPE	Standardized Prediction Error
SSN	Social Security Number
YAR	Year at Risk
YOS	Years of Service

I. INTRODUCTION

BACKGROUND

Air Force personnel managers use *inventory projection models (IPMs)* to predict how an initial inventory of airmen will look in the future. Such IPMs contain *loss models* that estimate how many members of the initial inventory leave the service by the future period in question. These loss models may differ by time horizon and by the extent to which the loss rates are aggregated. *Middle-term disaggregate loss models* predict annual loss rates by Air Force Specialty Code (AFSC) and certain other factors.

In 1983, as part of a larger effort to develop a new Enlisted Force Management System (EFMS) for the Air Force (Carter et al., 1983), RAND began developing a set of middle-term disaggregate loss models. Specification and estimation of these models continues to this day. This Note describes the test and evaluation[1] of these models as they were in May 1986. The models tested are those specified in Carter et al., 1987.

The testing and evaluation described here showed that the loss models as they stood in May 1986 were good enough to be encouraging, but not good enough to be satisfying. Few of the models were actually validated, but in general they performed at least as well as the disaggregate loss models used in ALPS. The exercise was primarily *diagnostic*; it identified several specific problems, some of which have been corrected already, some of which are being corrected, and some of which will receive attention in the future. These corrections should result in models whose performance is clearly superior to the ones evaluated here. By the time the EFMS becomes operational, the models evaluated here will have been modified and updated. Their performance will differ from that shown here.

This Note also describes how the evaluation was performed. Work on the models continues, and the Air Force intends to periodically respecify and refit the models as new data become available and the nature of the enlisted force changes. This document shows by example how the new models can be tested, how the act of testing the models

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[1]To test and evaluate a model means to compare its performance with that of the real world. To validate a model means that the model was accurate enough to be used for its designed purpose. The effort reported here emphasized testing and evaluation.

can reveal the strengths of the new models, and how it can suggest areas where further work could lead to improvements.

For readers interested in *performance*, the report contains many tables that compare the predictions of the models documented in Carter et al., 1987, with actual loss rates and with the corresponding loss rates estimated by the model currently being used by the Air Force.

For readers largely interested in *diagnostics*, the same tables indicate where the models are weakest, and may suggest both reasons for the problems and ways to correct them.

Readers interested in *technique* can see how the tables were calculated. Both the theory and some of the detail are presented.

OUTLINE

The basic models calculate loss rates for a construct called a *year at risk*. Section II defines this idea, describes how estimated loss rates were compared with actual ones, and presents the results.

The Air Force needs loss rates for fiscal years, and the process of calculating fiscal year loss rates using year-at-risk loss rates is called *blending*. Section III describes the theory and practice of blending that was used in the test and evaluation and compares the blended loss rates with actual ones.

The Air Force currently uses a model called the *Airman Loss Probability System (ALPS)* to calculate loss rates, and the middle-term disaggregate loss models described here will eventually replace ALPS. Section IV compares the loss rates derived from ALPS and the new models.

II. TEST AND EVALUATION OF THE COHORT MODELS

INTRODUCTION

These models were estimated with a 40 percent sample of airmen who were in the Air Force during the seven-year period from fiscal year (FY) 1977 through FY 1983. The evaluation described here used 10 percent samples of airmen who were in the Air Force in FY 83, FY 84, and FY 85.[1] The models are described in Carter et al., 1987.

These results adopt a "top down" approach, beginning at the most general, least detailed level by comparing the performance of all the models combined. Successively less general and more detailed levels are then considered. First the net performance of the individual models are compared, then the performance of each model is examined with various subgroups of airmen to whom the model applies.

All of the models make loss-rate predictions. Several of the models also make "extend-given-stay" predictions. Only the loss rate predictions will be discussed at the general level; the extend-given-stay predictions will be treated in the sections devoted to the individual models.

Cohort Evaluation

The middle-term disaggregate loss models estimate the probability of loss and the probability of extending given nonloss for a year at risk.

The term *year at risk* can be defined recursively.

1. Any day an airman enlists or reenlists is called an anniversary.
2. If, during the year following an anniversary, the airman neither reenlists nor quits, the first day of the next year is called an anniversary.
3. The entire year following any anniversary is called a year at risk.

Figure 1 illustrates the definitions of anniversary and year at risk. The symbol "|" represents an anniversary, and the symbol "|——→" represents a year at risk. This airman experienced seven anniversaries and seven years at risk. There was one period

[1]To remain consistent with the estimation procedures, our fiscal years begin in July, so FY 83, for example, begins in July 1982.

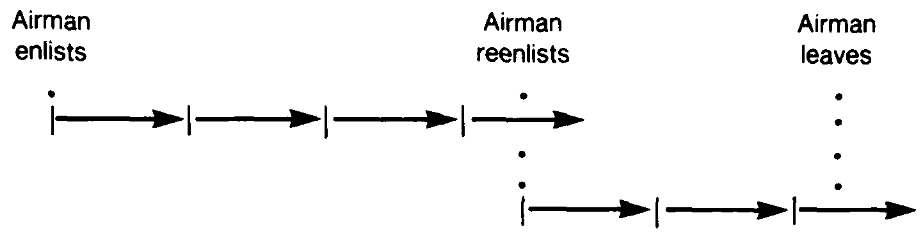

Fig. 1—Hypothetical Airman Career

when two years at risk overlapped, because he reenlisted for a second term before the expiration of his first term. Also, for the last part of his last year at risk he was no longer in the service.

Every airman has some characteristics that remain constant from one year at risk to the next (e.g., sex, age at first enlistment), some that change only occasionally (e.g., education, marital status), and some that may change often (e.g., grade, occupational class). Each year at risk has characteristics of its own (e.g., the date it begins, the date it ends, the unemployment rate, the military/civilian pay ratio). For each airman, these data can be assembled into a rectangular file whose rows are the successive years at risk experienced by that airman. The airman whose career is illustrated in Fig. 1 would contribute seven records to this file. Merging these airman files over the entire force (or a sample) yields the *Year-At-Risk (YAR) file*, which was used both to estimate and to evaluate the loss models.

For any particular airman, a given day might lie between the beginning and end of one or more of his years at risk; when this happens one says the year at risk *covers* the day in question. (More than one year at risk can cover a particular day when he reenlists in a new term before the end of the previous one.) Any particular day defines a *cohort* of airmen: all the airmen who experienced a year at risk that covered that day. This Note discusses the loss model evaluation that was performed with cohorts defined by the beginning of fiscal years 1983, 1984, and 1985.

Ten loss models have been developed. They differ according to the the term of service to which they apply—first, second, career (any nonretirement term beyond the second), and retirement. Furthermore, first, second, and career models subdivide into end of term of service (ETS) models (years at risk during which the term is scheduled to end), attrition models (earlier years of a term), and extension models (later years of a term). The 10 models, along with an acronym for each, are:

1ATT	First term attrition
1ETS	First term ETS
1EXT	First term extension
2ATT	Second term attrition
2ETS	Second term ETS
2EXT	Second term extension
CATT	Career attrition
CETS	Career ETS
CEXT	Career extension
RET	Retirement

Loss predictions for a cohort of airmen over some year at risk is not by itself of any practical interest. What *is* important is the estimation of the size of the force at the end of a fiscal year (end strength) given its size at the beginning. During any given fiscal year, two or three different loss models may be needed to calculate the probability that some particular airman will be lost during that fiscal year. The technique of combining the loss models to make such a calculation is called *blending*. Once blending is completed, the models can be evaluated by seeing how closely the predicted end strength compares with the actual: Making such comparisons is called *fiscal year evaluation*. Blending and fiscal year evaluation are discussed in Sec. III.

Evaluation Measures

This section will define several measures of *fit* illustrating these definitions with an example. Using all 10 models to predict losses for a 10 percent sample of airman records from the YAR file (all airmen with a Social Security Number—SSN—that ends in a 3) for fiscal year 1983, yields:

Number of airmen at risk	50,987
Predicted losses	5,686
Actual losses	5,934

Prediction error (PE) is simply the number of predicted losses minus the number of actual losses. In this example, the prediction error is –248. The size of the prediction error depends partly on the accuracy of the model. It is positive if the model overpredicts losses, negative if the model underpredicts losses. But its size also depends

on the number of airmen at risk of loss; and unless this number is known, prediction error is almost meaningless.

A loss prediction also implies a survival (retention) prediction. The survival prediction error (number of predicted survivors minus the number of actual survivors) is just the negative of the prediction error, so there is a certain symmetry in this measure.

Percent Relative Error (PRE) is defined to be the prediction error divided by the number of actual losses, times 100. In the example, this rate is –4.2 percent. Since these models are called *loss models*, PRE seems to be a natural measure of performance. However, it has some peculiar properties:

1. If loss rates are low, the PRE can be quite large, even though the prediction error itself is small.
2. If we are not interested in the number of losses, but in the number of survivors, the corresponding error rate would be the survival prediction error divided by the number of survivors. If losses are low and the number of airmen at risk is high, then the survival PRE will be small, while the loss PRE will be high. In this example, the survival PRE is 0.55 percent, an order of magnitude lower than the loss PRE. Thus, PRE is an ambiguous measure of performance, unless the user has some reason to value accuracy in one prediction (e.g., loss prediction) over accuracy in the other (e.g., survival prediction).

A more symmetric measure is *prediction error as percent of number at risk (PEPNR)*, defined to be the prediction error divided by the number of airmen at risk, times 100. In this example, this rate is –0.49 percent. If these models can be thought of as predicting whether an airman will be lost during an applicable year at risk, PEPNR measures the net error rate—the net number of false negatives (if PEPNR is negative) or false positives (if PEPNR is positive) as a percent of the number of predictions made. PEPNR for survivals is just the negative of PEPNR for losses.

These three measures are purely descriptive ones. One more is called *standardized prediction error (SPE)*. Its definition requires some discussion.

Each middle-term disaggregate loss model is a linear combination of the form:

LOSS = Constant

+ Parameter(1) * Variable(1)

+ Parameter(2) * Variable(2)

+ . . .

+ Parameter(n) * Variable(n)

Each model applies to individual airmen. In any particular year at risk, each airman is described by the variables in the model; and each model is characterized by the variables used and the estimates of the constant and the parameters.

Generally, the value assigned to LOSS is a number that lies strictly between 0 and 1. Because an airman either leaves or does not, LOSS has to be interpreted as a probability. For any group of airmen, the values assigned to LOSS may be added for all airmen in the group to predict the number of losses within this group. But because LOSS is a probability, the actual number of losses in any group does not have to agree exactly with the predicted number. Disagreement between the predicted number and actual number of losses within any group is expected and does not necessarily invalidate the model.

The actual number of losses will differ from the predicted number by chance alone, even if the model represents reality perfectly. It may even differ by a large amount, but as the difference gets larger, the probability of that difference gets smaller. If that probability is small enough, something must be wrong with the model.

Calculating the probability of observing a given difference between the actual and predicted number of losses is no simple matter. The main problem is that the equations expressing the models do not in and of themselves give a complete description of what we think, or at least what we are willing to hypothesize. The two main problems are homogeneity and independence.

Homogeneity. The question here is whether a model assigns each airmen his *exact* loss probability, or whether it merely assigns the correct loss probability to some class of airman to which that airman belongs.

Most of the variables used in the loss models are categorical ones—they take on just a few values. In fact, most are dummy variables—variables that take on only the values 0 or 1. (The two important exceptions are the unemployment rate and the military/civilian pay ratio; but for any given fiscal year, the unemployment rate changes

very little and the pay ratio changes not at all, so for the purposes of evaluation these two variables can be regarded as part of the constant term.) In effect, each model partitions the force into a small number of categories and assigns the same loss probability to each airman in any one category. The question of homogeneity is whether within each of these categories the loss probability assigned to each airman is exactly his loss probability, or whether it is simply the average loss probability for all airman in that group. If the former is true, then the sample is homogeneous (with respect to this model).

If the sample is homogeneous with respect to some model, it is possible to calculate the probability distribution of the predicted number of losses in any particular sample (but see the next section on independence) and then to assign a probability to observing any specified difference between actual and observed losses.

Of course, no one believes our samples are homogeneous. In any stratum defined by these models, there are surely other variables the model does not use, perhaps are not even contained in the YAR file, that would partition that stratum into further groups of airmen where the loss probabilities would be substantially different from group to group. But these new variables are unknown, as are how different the new loss probabilities would be.

Without homogeneity, probability calculations have to be made with a homogeneity *assumption*, but the results must be interpreted with the understanding that the assumption may be wrong.

Independence. The question here is whether each airman leaves the force independently of the choices made by other airmen. An assumption about independence is required to calculate the distribution of the actual number of losses.

If the sample were homogeneous with respect to the model, then for any subgroup defined by the model whose size is n and whose predicted loss rate is p, the predicted number of losses will be np. If within this group the airmen act independently, the actual number of losses will be a binomially distributed random variable with mean $n*p$ and variance $n*p*(1-p)$.

At another extreme, the airmen could always act in concert (all leave together or stay together), but they all leave with probability p or stay with probability $1-p$. This situation could still be appropriately represented by one of these models, and the best prediction of the number of losses is $n*p$. The average number of airmen lost will still be

n*p, but the actual number will be a random variable equal to n with probability p and 0 with probability 1 – p, and its variance will be n times bigger than the variance of the independent case.

As a third alternative, all the airmen might want to leave, but some kind of policy constrains things so that once the fraction p has left, no further losses are allowed. In other words, exactly the fraction p leaves, no more, no less. The models still appropriately represent this situation, and the best prediction of the number of losses is n*p. In that case, the actual number of losses will be exactly n*p, the variance will be zero, and our predictions will always be perfect.

Thus, depending on the degree of independence of choice among airmen in any homogeneous group, the variance of the actual number of losses can be quite different.

In fact, airmen probably do not act independently. Situations similar to those mentioned above, though not as extreme, probably occur. Within some model stratum, some kinds of exogenous events might occur that simultaneously affect the decisions of several different airmen. After a certain number of losses, the service might place a block in front of any further losses or offer some additional inducement to stay.

The statistical measure introduced here tests the hypothesis that our predicted loss rate is the "true" loss rate, under the assumptions that the population is homogeneous with respect to the model, and that airmen act independently. Under this hypothesis, the number of losses in any group will be a random variable whose mean m is

$$m = N*p$$

and whose variance v is larger than

$$v = N*p*(1 - p)$$

where

N = number of airmen at risk in the group

p = predicted loss rate for the entire group

If N is large enough, under this hypothesis the standardized prediction error (SPE), given by

SPE = PE/sqrt(v),

is approximately normally distributed with variance less than 1. This means that the probability of observing a given prediction error can be estimated from tables of the standard normal distribution

Prob(|SPE| > z) > Prob(|Z| > z).

Generally, if the absolute value of SPE exceeds 2, the hypothesis of a homogeneous population of independently acting airmen with the given loss rate can be rejected.

For the example, SPE is 3.5, which means the hypothesis of a perfect statistical fit can be rejected. Of course, the sample is not homogeneous, or there would not be so many models. However, this fact alone probably does not explain the lack of fit. As will be seen in Sec. III, several of the individual models do not fit the data well. But more important, with large sample sizes, statistical models rarely fit the data, especially when the models attempt to predict human behavior. Given the complexity of the process modelled here, and the size of the sample (over 50,000 cases), a 3.5 standard deviation error is probably not too bad.

COMPARING THE MODELS

The "top down" approach to describing the evaluation results first consider briefly what happens when the predictions of all 10 models are combined to estimate the net number of losses for the entire sample. The predictions of the 10 models are compared with actual losses, first for fiscal year 1983 and then for fiscal years 1984 and 1985.

Fiscal year 1983 was used for estimation. There are two reasons to use it for evaluation as well. First, it verified the implementation of the loss models in the form of executable code. Making calculations for 1983 and seeing that the predicted and actual loss rates are close helps to confirm that the implementation is correct. Second, even though 1983 data were among those used to estimate the models, there is no guarantee that the models will necessarily perform well for 1983. Loss rates in 1983 might be quite different from those in previous years, and the model will predict average loss rates perfectly only if the averages are taken from the entire seven-year period. Using 1983 by itself is therefore a useful test of the model.

Comparisons When Loss Rates Are Combined

The overall performance of the 10 models for the three years is as shown in Table 2.1.

This display suggests that the overall performance of the models is quite good. The relative prediction error is at most 5.6 percent (in FY 85, which is two years beyond the data used to estimate the model). But even in FY 85, the models taken together predict only 333 losses too many, out of nearly 52,000 airmen in the sample. The standardized prediction error has increased (in absolute value) by 1 standard deviation over the level in FY 83.

Comparing the Models for Fiscal Year 1983

Table 2.2 summarizes the performance of each of the 10 models for FY 83. Recall that data for 1983 were used to estimate the coefficients of these models, so good performance for this year's data would be expected if the evaluation code were correctly written.

Four of the models, 2ATT, 2ETS, CATT, and CEXT, exhibit large relative errors. However, in the case of CEXT the number of losses is low, and because the standardized prediction error is low the prediction error could be due to chance alone.

The second-term and career attrition models exhibit errors that cannot be so easily dismissed. In each case, the actual number of losses is more than 3.5 standard deviations from the predicted number. The error seen in the second-term ETS model is large enough to be noted, but not large enough to be alarming. Predicted losses exceed actuals by a little over two standard deviations. Although the probability of such an event is

Table 2.1

OVERALL PERFORMANCE, 10 MODELS, FY 83-86

Item	FY 83	FY 84	FY 85
Number of airmen at risk	50,987	51,769	51,933
Predicted losses	5,686	5,567	6,299
Actual losses	5,934	5,592	5,966
Prediction error (PE)	−248	−25	333
Percent relative error (PRE)	−4.2	−0.4	5.6
Error as % of N at risk (PEPNR)	−0.5	−0.1	0.6
Standardized prediction error (SPE)	−3.5	−0.4	4.5

Table 2.2

PERFORMANCE OF ALL LOSS MODELS FOR FY 83

Model	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
1ATT	19461	9.57	9.95	-74	-3.8	-0.38	-1.80
1ETS	4283	34.47	35.86	-60	-3.9	-1.39	-1.91
1EXT	2850	30.81	31.23	-12	-1.3	-0.42	-0.49
2ATT	7117	1.98	2.61	-45	-24.1	-0.63	-3.82
2ETS	1203	14.26	12.05	27	18.3	2.21	2.19
2EXT	1037	14.71	14.27	5	3.1	0.44	0.40
CATT	9169	0.68	1.06	-35	-35.8	-0.38	-4.43
CETS	1617	1.76	1.67	1	5.4	0.09	0.28
CEXT	829	3.77	4.34	-5	-13.1	-0.57	-0.86
RET	3421	25.78	27.27	-51	-5.5	-1.49	-1.99
Total	50987	11.15	11.63	-248	-4.2	-0.49	-3.50

under 5 percent, the probability of its occurrence in 10 trials exceeds 20 percent, so it is not surprising to see a difference this large at least once in a list of this sort.

Comparing the Models for Fiscal Years 1984 and 1985

Table 2.3 compares actual and predicted loss rates for all three fiscal years. Data for FY 84 and FY 85 were not used to estimate the parameters of these models, so Table 2.3 represents a more severe test than does Table 2.2.

Considering standardized prediction error only, six of the models (1ATT, 1EXT, 2EXT, CETS, CEXT, and RET) perform exactly as one would expect an unbiased model to behave. Of these six models and three fiscal years, there is only one example where the SPE exceeds 2 (2EXT in FY 85).

As in FY 83, 2ATT, 2ETS, CATT, and CEXT exhibit large PREs in both FY 84 and FY 85. As in FY 83, CEXT loss rates are extremely low, and because the standardized prediction error is small, the error seen in that model is no cause for concern.

The two attrition models 2ATT and CATT continue to display the large SPEs seen in FY 83, suggesting something may be wrong with either the specification or the implementation of these two models. In both models, the problem lies in the failure of the models to predict big changes in the actual loss rates; in other words, the models are

Table 2.3

PERFORMANCE OF ALL LOSS MODELS, FY 83, FY 84, AND FY 85

Model	FY	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR(%)	SPE
1ATT	83	19461	9.57	9.95	−74	−3.8	−0.4	−1.80
	84	19043	9.04	9.00	8	0.4	0.0	0.19
	85	18301	9.07	8.69	70	4.2	0.4	1.79
1ETS	83	4283	34.47	35.86	−60	−3.9	−1.4	−1.91
	84	4810	38.92	36.45	119	6.3	2.5	3.51
	85	4949	47.73	37.91	486	20.6	9.8	12.83
1EXT	83	2850	30.81	31.23	−12	−1.3	−0.4	−0.49
	84	2076	30.95	30.49	10	1.5	0.5	0.45
	85	1706	32.75	31.65	19	3.4	1.1	0.97
2ATT	83	7117	1.98	2.61	−45	−24.1	−0.6	−3.82
	84	8702	2.07	3.92	−161	−89.4	−1.9	−12.12
	85	9308	2.26	4.86	−242	−115.0	−2.6	−16.88
2ETS	83	1203	14.26	12.05	27	18.3	2.2	2.19
	84	1410	15.72	13.26	35	15.6	2.5	2.54
	85	1390	21.88	17.27	64	21.1	4.6	4.16
2EXT	83	1037	14.71	14.27	5	3.1	0.4	0.40
	84	759	14.92	14.10	6	5.5	0.8	0.63
	85	736	19.09	14.67	33	23.2	4.4	3.05
CATT	83	9169	0.68	1.06	−35	−35.8	−0.4	−4.43
	84	9631	0.67	1.09	−40	−62.7	−0.4	−5.05
	85	9910	0.70	1.49	−78	−112.9	−0.8	−9.43
CETS	83	1617	1.76	1.67	1	5.4	0.1	0.28
	84	1741	2.16	2.35	−3	−8.8	−0.2	−0.55
	85	1639	2.55	2.93	−6	−14.9	−0.4	−0.98
CEXT	83	829	3.77	4.34	−5	−13.1	−0.6	−0.86
	84	690	4.10	2.90	8	29.3	1.2	1.59
	85	679	4.67	5.15	−3	−10.3	−0.5	−0.59
RET	83	3421	25.78	27.27	−51	−5.5	−1.5	−1.99
	84	3360	24.51	24.40	4	0.4	0.1	0.15
	85	3315	27.76	28.02	−9	−0.9	−0.3	−0.33

unresponsive rather than overreactive. Of course, an error in the estimate of the *actual* loss rate is another possible reason for the differences.

The second-term ETS model exhibits the same marginal performance seen in FY 83, with standardized prediction errors a little too large to be satisfactory, especially when seen in three successive fiscal years.

Models for Extend-Given-Stay Rates

In addition to estimating loss rates, each of the ETS models estimates the rate at which airmen extend their terms, given they do not leave. This rate is the *extend-given-stay* rate.

Naturally enough, these models were estimated using the subsample of airmen who did not leave the service at the end of the term year. Unfortunately, the models cannot be applied to exactly this group of airmen. The loss models do not predict who will leave, they only assign a probability of leaving to each airman. After this probability is assigned, there is no subset of airmen that can be designated as "having stayed" to which the extend-given-stay model may be applied. Consequently, to test these models the extend-given-stay rate was calculated for *every* airman. This was compared with an "actual" rate obtained by dividing the number of airmen who extended by the number who did not leave. This causes another problem: The samples used to calculate a predicted rate and an actual rate are different; the sample used to calculate the actual rate is a subset of the sample used to calculate the predicted rate. To make the same kinds of comparisons (prediction error, percent relative error, etc.) as made for loss rates, the number of airmen at risk is taken for the number that actually stayed, even though the prediction was based on a larger sample.

Table 2.4

PERFORMANCE OF EXTEND-GIVEN-STAY MODELS, FY 83, FY 84, FY 85

Term	FY	Airmen at Risk	Extend-Given-Stay Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
1st	83	2747	48.08	48.34	−7	−0.5	−0.2	−0.22
	84	2755	48.63	41.45	198	14.8	4.4	5.89
	85	3073	47.84	39.86	245	16.7	5.0	6.98
2nd	83	1058	40.94	36.11	51	11.8	4.2	3.00
	84	1223	41.24	36.39	59	11.8	4.2	3.21
	85	1150	49.75	41.22	98	17.1	7.1	5.26
Career	83	1590	22.50	28.99	−103	−28.8	−6.4	−6.15
	84	1700	21.93	28.53	−112	−30.1	−6.4	−6.50
	85	1591	21.70	29.16	−119	−34.4	−7.2	−7.11

Table 2.4 compares actual and predicted extend-given-stay rates for all three models and all three fiscal years used in the evaluation. As can be seen, the models do not perform as well as the loss models.

DETAILED DISCUSSION OF THE MODELS

For each of the 10 models, and for each fiscal year (1983, 1984, and 1985), predicted and actual loss rates were calculated for all airmen in the 10 percent YAR sample designated SSN3 (Carter et al., 1987). To evaluate the performance of the models over different groups of airmen, these samples were also stratified with seven factors and loss rates calculated for all airmen within the strata defined by these factors. The seven factors used were:

- Occupational group
- Year of term
- Bonus multiple
- Grade
- Term of enlistment
- Decision status (extension models)
- Missing values

The models apply to airman samples ranging from around 20,000 cases (first-term attrition) to around 1,000 cases (second-term extension). When the samples were stratified with respect to one or another of the above factors, some of the resulting strata were too small to provide interesting information about the model's performance. Results for such small strata are not reported.

First-Term Attrition

The first-term attrition model[2] applies to approximately 20,000 airmen, about 40 percent of the sample. We examine the performance of this model using two strata: term year (Table 2.5) and Career Field Group (Table 2.6).[3] Because many airmen do not

[2]Carter et al. (1987), Table 2.2 and Table 2.3.

[3]Career Field Groups (CFGs) are defined in Table A.1 of Carter et al. (1987). They are:

Skilled Technicians	(SkilTech)
Electrical/Mechanical Equipment Repairmen	(ElMcRepa)
Functional Support and Administration	(Support)
Craftsmen, Service and Supply Handlers	(CrfSerSu)

appear to receive occupational classifications until their third year, the latter table is restricted to such airmen.

This model's performance is generally good. The largest standardized prediction error for a single fiscal year occurred in FY 83 but was within acceptable limits, underpredicting the number of losses by only 74 airmen out of a total of over 19,000 at risk. During that year, the predicted loss rate practically coincided with the actual rate for first-year airmen, a good sign because the submodel for first-year airmen is a bit complicated. In FY 84 the overall predicted loss rate almost coincides with the actual, but within term years the model overpredicts loss rates for first- and second-year airmen and underpredicts such losses for airmen in their third year. This underprediction is the sharpest discrepancy seen in these tables, but no such error occurs in FY 85, where in fact the model predicts losses quite accurately.

Errors by CFGs for the most part fall within acceptable bounds. Predicted loss rates in FY 84 are low for third-year airmen, and this underprediction is seen consistently for all four CFGs that year. Whatever happened to affect the overall loss rate for those airmen affected them consistently with respect to CFG.

Table 2.5

FIRST-TERM ATTRITION LOSSES BY TERM YEAR

FY	Term Year	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	19461	9.57	9.95	−74	−4.0	−0.4	−1.80
	1	7188	11.49	11.48	1	0.1	0.0	0.03
	2	6470	8.45	8.92	−30	−5.6	−0.5	−1.36
	3	5528	8.43	9.33	−50	−10.7	−0.9	−2.41
84	All	19043	9.04	9.00	8	0.4	0.0	0.19
	1	6151	11.04	9.40	101	14.9	1.6	4.10
	2	6362	8.95	8.16	50	8.8	0.8	2.21
	3	5886	7.10	9.43	−137	−32.8	−2.3	−6.96
85	All	18301	9.07	8.69	70	4.2	0.4	1.79
	1	5994	10.62	10.63	−1	−0.1	−0.0	−0.03
	2	5569	8.97	7.09	105	21.0	1.9	4.91
	3	5843	7.75	7.94	−11	−2.5	−0.2	−0.54

Table 2.6

FIRST-TERM ATTRITION LOSSES BY CAREER FIELD GROUP
(Third year)

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	5528	8.43	9.33	−50	−10.7	−0.9	−2.41
	SkilTech	1744	7.29	8.14	−15	−11.7	−0.8	−1.37
	ElMeRepa	1641	8.20	10.05	−30	−22.6	−1.9	−2.73
	Support	1159	8.05	8.80	−9	−9.3	−0.7	−0.94
	CrfSerSu	925	11.49	10.81	6	5.9	0.7	0.65
84	All	5886	7.10	9.43	−137	−32.8	−2.3	−6.96
	SkilTech	1500	6.46	9.27	−42	−43.5	−2.8	−4.43
	ElMeRepa	1601	7.65	10.18	−41	−33.1	−2.5	−3.81
	Support	806	7.90	12.78	−39	−61.8	−4.9	−5.14
	CrfSerSu	730	11.15	16.03	−36	−43.8	−4.9	−4.19
85	All	5843	7.75	7.94	−11	−2.5	−0.2	−0.54
	SkilTech	2084	5.93	6.48	−11	−9.3	−0.6	−1.06
	ElMeRepa	1848	7.71	7.90	−4	−2.5	−0.2	−0.31
	Support	840	7.89	9.52	−14	−20.7	−1.6	−1.75
	CrfSerSu	1055	11.25	9.48	19	15.7	1.8	1.82

First-Term ETS

The first-term ETS model has two parts. One part calculates loss rates; the other, extend-given-stay rates.

First-Term ETS Losses. The first-term ETS loss model[4] applies to approximately 4,000 airmen, or about 8 percent of the entire sample. The performance of this model is examined with respect to CFG (Table 2.7), bonus (Table 2.8), and the presence or absence of certain variables needed by the model (Table 2.9).

Although this model does a good job in FY 83, its performance deteriorates in FY 84, and in FY 85 it sharply overpredicts actual losses. In FY 85, for example, it predicts nearly 500 more losses than were actually observed, out of approximately 5,000 airmen at risk. This overprediction is seen in all four CFGs, and is unaffected by presence or absence of a bonus.

[4] Carter et al. (1987), Table 5.2.

Table 2.7

FIRST-TERM ETS LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	4283	34.47	35.86	−60	−4.0	−1.4	−1.91
	SkilTech	1409	36.74	38.40	−23	−4.5	−1.7	−1.29
	ElMeRepa	1217	35.86	34.76	13	3.1	1.1	0.80
	Support	910	25.55	27.47	−17	−7.5	−1.9	−1.33
	CrfSerSu	729	38.74	43.62	−36	−12.6	−4.9	−2.70
84	All	4810	38.92	36.45	119	6.3	2.5	3.51
	SkilTech	1400	41.33	37.79	50	8.6	3.5	2.69
	ElMeRepa	1347	41.32	37.64	50	8.9	3.7	2.74
	Support	1043	30.01	33.08	−32	−10.2	−3.1	−2.16
	CrfSerSu	682	42.72	37.39	36	12.5	5.3	2.81
85	All	4949	47.73	37.91	486	20.6	9.8	13.83
	SkilTech	1617	49.96	40.69	150	18.6	9.3	7.46
	ElMeRepa	1810	49.60	38.12	208	23.1	11.5	9.77
	Support	873	38.41	29.67	76	22.8	8.7	5.31
	CrfSerSu	636	49.38	41.35	51	16.3	8.0	4.05

Table 2.8

FIRST-TERM ETS LOSSES BY BONUS

FY	Bonus	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	4283	34.47	35.86	−60	−4.0	−1.4	−1.91
	None	2337	32.47	33.93	−34	−4.5	−1.5	−1.51
	1	1171	35.32	36.04	−8	−2.0	−0.7	−0.52
84	All	4810	38.92	36.45	119	6.3	2.5	3.51
	None	2719	36.62	35.12	41	4.1	1.5	1.62
	1	629	39.61	37.04	16	6.5	2.6	1.32
85	All	4949	47.73	37.91	486	20.6	9.8	13.83
	None	2744	45.41	35.46	273	21.9	9.9	10.47
	1	688	47.62	37.35	71	21.6	10.3	5.39

One problem with testing the first-term ETS model is the presence of many cases in the YAR file with missing data. There are two causes. First, the model uses the airman's Air Force Specialty Code (AFSC) code to look up the value of its cross-bonus variable.[5] But for many airmen, the required value could not be found. Second, in several cases the value of the airman's bonus coefficient was unknown.

Cases with missing data were given a default value for the missing variable. Because the first-term ETS model was the only one with such a large number of such missing cases, these missing cases might account for the problems described above. Table 2.9 shows the model's performance for that subset of cases where no missing valu 's were found, for those cases where *only* the cross-bonus variable (WBONC) was missing, and for those cases where both WBONC and the bonus coefficient were missing. In FY 85, the problem year, the model performs better, if anything, on the cases with missing data than on the cases with no missing data. The prediction errors are therefore not caused by the missing values.[6]

Extend-Given-Stay Rates. In our sample, the first-term ETS model applies to around 4,000 airmen, with a loss rate of around 35 percent, hence approximately 2,700 airmen remain and are faced with the "extend-given-stay" decision. The performance of

Table 2.9

FIRST-TERM ETS LOSSES BY WHAT'S MISSING

FY	What's Missing	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	Nothing	3577	34.45	35.87	–51	–4.1	–1.4	–1.79
	WBONC	234	36.48	37.61	–3	–3.1	–1.1	–0.36
	WBONC+BONUS	465	33.64	64.62	–144	–92.1	–31.0	–14.14
84	Nothing	3736	38.69	36.51	81	5.6	2.2	2.74
	WBONC	226	40.09	34.07	14	15.0	6.0	1.85
	WBONC+BONUS	521	40.15	38.00	11	5.4	2.2	1.00
85	Nothing	3072	46.96	37.24	299	20.7	9.7	10.79
	WBONC	1375	48.52	37.89	146	21.9	10.6	7.89
	WBONC+BONUS	497	50.21	41.85	42	16.7	8.4	3.73

[5]Carter et al. (1987), Table 5.2.

[6]This is one of several models that have been reestimated using a different mathematical specification as a result of the test and evaluation process.

this model[7] is examined with respect to Career Field Group (Table 2.10), bonus (Table 2.11), and missing values (Table 2.12).

The model performs extremely well in FY 83 but poorly in both FY 84 and FY 85. In general, the overall extend-given-stay rate dropped sharply in FY 84 and remained there in FY 85, and the model was unable to follow this drop. Some subgroups where the rate was underpredicted in FY 83 (e.g., the CFG "Support") did better in FY 84 and FY 85, not because the rates fell in these groups, but because they were already low.

There is no evidence that the missing values cause the low predicted rates. The fact that the standardized prediction error is lower for the missing cases simply reflects the sample sizes being smaller.

First-Term Extension

The first-term extension model[8] applied to almost 3,000 airmen in FY 83, about 6 percent of the sample. By FY 85 the number had shrunk to around 1,700 airmen, about 3.4 percent of the sample. The performance of this model is examined with respect to

Table 2.10

FIRST-TERM EXTEND-GIVEN-STAY BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Stay Rates Predicted	Stay Rates Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	2747	48.08	48.34	−7	−0.5	−0.2	−0.22
	SkilTech	868	46.56	47.12	−5	−1.2	−0.3	−0.26
	ElMeRepa	794	45.47	41.69	30	8.3	2.5	1.73
	Support	660	48.84	52.27	−23	−7.0	−2.5	−1.50
	CrfSerSu	411	54.32	57.91	−15	−6.6	−2.0	−1.10
84	All	2755	48.63	41.45	198	14.8	4.4	5.89
	SkilTech	871	48.26	38.35	86	20.5	6.2	4.62
	ElMeRepa	840	46.47	37.02	79	20.3	5.9	4.34
	Support	698	48.69	45.85	20	5.8	1.9	1.23
	CrfSerSu	427	53.56	48.24	23	9.9	3.3	1.74
85	All	3073	47.84	39.86	245	16.7	5.0	6.98
	SkilTech	959	47.73	39.21	82	17.9	5.1	4.07
	ElMeRepa	1120	46.05	41.07	56	10.8	3.1	2.63
	Support	614	48.72	34.04	90	30.1	10.3	6.10
	CrfSerSu	373	51.95	47.18	18	9.2	2.8	1.41

[7] Carter et al. (1987), Table 5.2.

[8] Carter et al. (1987), Table 8.1 and Table 8.2.

Table 2.11

FIRST-TERM EXTEND-GIVEN-STAY BY BONUS

FY	Bonus	Airmen at Risk	Stay Rates Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	2747	48.08	48.34	−7	−0.5	−0.2	−0.22
	None	1544	50.44	51.88	−22	−2.9	−1.0	−0.92
	1	749	45.14	45.66	−4	−1.2	−0.3	−0.23
84	All	2755	48.63	41.45	198	14.8	4.4	5.89
	None	1764	49.66	44.44	92	10.5	3.4	3.53
	1	396	46.50	33.08	53	28.9	8.4	4.25
85	All	3073	47.84	39.86	245	16.7	5.0	6.98
	None	1771	49.16	41.39	138	15.8	5.0	5.25
	1	431	45.79	36.19	41	21.0	6.0	3.17

Table 2.12

FIRST-TERM EXTEND-GIVEN-STAY BY MISSING VALUES

FY	Missing	Airmen at Risk	Stay Rates Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	2747	48.08	48.34	−7	−0.5	−0.2	−0.22
	None	2294	48.89	49.26	−8	−0.8	−0.2	−0.28
	WBONC	146	45.02	36.30	13	19.4	5.4	1.67
	WBONC+BONUS	304	43.42	46.71	−10	−7.6	−2.2	−0.94
84	All	2755	48.63	41.45	198	14.8	4.4	5.89
	None	2372	49.34	42.16	170	14.6	4.6	5.57
	WBONC	149	46.82	41.61	8	11.1	3.4	1.03
	WBONC+BONUS	323	44.57	34.67	32	22.2	6.1	2.82
85	All	3073	47.84	39.86	245	16.7	5.0	6.98
	None	1928	48.53	38.59	192	20.5	6.2	6.92
	WBONC	854	47.48	42.51	42	10.5	3.1	2.29
	WBONC+BONUS	289	44.56	40.48	12	9.2	2.4	1.06

Career Field Group (Table 2.13), bonus (Table 2.14), grade (Table 2.15), and whether the airman was in a decision year (Table 2.16).

This model seems to be rather good. The standardized prediction error rarely exceeds 1 in absolute value in any fiscal year and for any stratum. Curiously, the model does best in FY 85, two years beyond the data used to estimate it. Extension models

Table 2.13

FIRST-TERM EXTENSION LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	2850	30.81	31.23	−12	−1.4	−0.4	−0.49
	SkilTech	871	35.67	33.87	16	5.0	1.8	1.11
	ElMeRepa	832	30.83	31.25	−3	−1.4	−0.4	−0.26
	Support	631	25.90	30.11	−27	−16.3	−4.2	−2.41
	CrfSerSu	491	27.59	27.29	1	1.1	0.3	0.15
84	All	2076	30.95	30.49	10	1.5	0.5	0.45
	SkilTech	643	35.69	37.48	−12	−5.0	−1.8	−0.95
	ElMeRepa	503	30.40	27.24	16	10.4	3.2	1.54
	Support	540	26.79	28.33	−8	−5.7	−1.5	−0.81
	CrfSerSu	371	28.39	26.15	8	7.9	2.2	0.96
85	All	1706	32.75	31.65	19	3.4	1.1	0.97
	SkilTech	491	39.58	37.88	8	4.3	1.7	0.77
	ElMeRepa	433	30.84	31.41	−2	−1.8	−0.6	−0.26
	Support	470	27.26	25.96	6	4.8	1.3	0.63
	CrfSerSu	302	32.44	30.79	5	5.1	1.6	0.61

Table 2.14

FIRST-TERM EXTENSION LOSSES BY BONUS

FY	Bonus	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	2850	30.81	31.23	−12	−1.4	−0.4	−0.49
	None	1769	29.92	31.03	−20	−3.7	−1.1	−1.02
	1	884	31.06	31.00	1	0.2	0.1	0.04
84	All	2076	30.95	30.49	10	1.5	0.5	0.45
	None	1287	30.04	31.08	−13	−3.5	−1.0	−0.81
	1	557	31.48	27.47	22	12.7	4.0	2.04
85	All	1706	32.75	31.65	19	3.4	1.1	0.97
	None	1129	30.65	29.23	16	4.6	1.4	1.03
	1	252	39.55	39.65	−0	−0.3	−0.1	−0.03

Table 2.15

FIRST-TERM EXTENSION LOSSES BY GRADE

FY	Grade	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	2850	30.81	31.23	−12	−1.4	−0.4	−0.49
	E-4	2124	30.44	30.04	8	1.3	0.4	0.40
	E-5	608	31.41	30.59	5	2.6	0.8	0.44
84	All	2076	30.95	30.49	10	1.5	0.5	0.45
	E-4	1275	26.58	26.04	7	2.0	0.5	0.44
	E-5	665	38.05	40.00	−13	−5.1	−2.0	−1.04
85	All	1706	32.75	31.65	19	3.4	1.1	0.97
	E-4	1346	31.33	30.65	9	2.2	0.7	0.54
	E-5	275	37.13	28.73	23	22.6	8.4	2.88

contain two submodels, one that applies to airmen in the first year of a two-year extension, where such losses as may occur correspond to attrition losses, and another model that applies to airmen in the last year of an extension. Table 2.16 compares the performance of the first-term extension model by the decision status.

The loss rates are very different for decisionmakers and nondecisionmakers. But the fraction of all airmen at risk who are decisionmakers can change quite substantially

Table 2.16

FIRST-TERM EXTENSION LOSSES BY DECISIONMAKER STATUS

FY	Attrition /Decision	Airmen at Risk	Loss Rate (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	2850	30.81	31.23	−12	−1.4	−0.4	−0.49
	Attrition	844	5.01	5.09	−1	−1.6	−0.1	−0.11
	Decision	2006	41.66	42.22	−11	−1.3	−0.6	−0.51
84	All	2076	30.95	30.49	10	1.5	0.5	0.45
	Attrition	606	5.03	6.11	−7	−21.5	−1.1	−1.22
	Decision	1470	41.63	40.54	16	2.6	1.1	0.85
85	All	1706	32.75	31.65	19	3.4	1.1	0.97
	Attrition	660	5.02	5.61	−4	−11.8	−0.6	−0.69
	Decision	1046	50.25	48.09	23	4.3	2.2	1.40

from one year to the next. Ir FY 83 decisionmakers made up about 70 percent of the airmen at risk, while in FY 85 they made up about 61 percent. A decrease in the decisionmaker fraction should lead to a decrease in the overall loss rate. However, between FY 83 and FY 85 the loss rates among decisionmakers increased, and so for the entire group, decisionmakers and nondecisionmakers, about the same fraction was lost in each fiscal year. The model was able to track these countervailing tendencies.

Second-Term Attrition

The second-term attrition model[9] applied to a little over 7,000 airmen in FY 83, about 14 percent of the force. By FY 85 this number had increased to a little over 9,000 and constituted about 18 percent of the force. The performance of this model is examined with respect to term year (Table 2.17), Career Field Group (Table 2.18), bonus (Table 2.19), grade (Table 2.20), and term of enlistment—TOE—(Table 2.21).

The model underpredicted loss rates slightly in FY 83; but loss rates were low, so the number of errors as a percent of the number of airmen at risk was also low. If the model had maintained this level of performance in subsequent years its performance would have been fair. However, actual loss rates increased sharply in both FY 84 and

Table 2.17

SECOND-TERM ATTRITION LOSSES BY TERM YEAR

FY	Term Year	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	7117	1.98	2.61	−45	−31.8	−0.6	−3.82
	1	2885	1.16	2.36	−35	−103.4	−1.2	−6.02
	2	2025	2.48	2.96	−10	−19.4	−0.5	−1.39
	3	1790	2.66	2.29	7	13.9	0.4	0.97
84	All	8702	2.07	3.92	−161	−89.4	−1.9	−12.12
	1	3109	1.32	3.81	−77	−188.6	−2.5	−12.16
	2	2785	2.44	4.38	−54	−79.5	−1.9	−6.64
	3	1950	2.73	3.54	−16	−29.7	−0.8	−2.19
85	All	9308	2.26	4.86	−242	−115.0	−2.6	−16.88
	1	2513	1.33	4.54	−81	−241.4	−3.2	−14.05
	2	3258	2.59	5.03	−79	−94.2	−2.4	−8.77
	3	2639	2.68	5.27	−68	−96.6	−2.6	−8.24

[9]Carter et al. (1987), Table 3.1.

FY 85, while the model's estimates changed very little. As a consequence, the errors were substantial by any measure in FY 85. The discrepancy is consistent over all the subgroups analyzed, but is not so severe for higher term years, presence of bonus, grade E-5 rather than grade E-4, and six-year term of enlistment. These observations suggest that older, more experienced airmen may be appropriately modeled, but that younger airmen are not. Recalling that the number of airmen to which this model has been applied has increased considerably between FY 83 and FY 84 suggests the possibility of an influx of a certain group of airmen that ought to be modeled differently. Refitting with more recent data should take care of the problem.

Second-Term ETS

The second-term ETS loss model has two parts. One part calculates loss rates; the other, extend-given-stay rates.

Table 2.18

SECOND-TERM ATTRITION LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	7117	1.98	2.61	−45	−31.8	−0.6	−3.82
	SkilTech	2321	1.90	2.61	−16	−37.4	−0.7	−2.51
	ElMeRepa	2261	1.73	2.26	−12	−30.6	−0.5	−1.93
	Support	1474	2.49	3.19	−10	−28.1	−0.7	−1.72
	CrfSerSu	874	2.22	3.09	−8	−39.2	−0.9	−1.75
84	All	8702	2.07	3.92	−161	−89.4	−1.9	−12.12
	SkilTech	2824	1.99	3.82	−52	−92.0	−1.8	−6.96
	ElMeRepa	2996	1.83	3.87	−61	−111.5	−2.0	−8.33
	Support	1685	2.05	4.27	−37	−108.3	−2.2	−6.43
	CrfSerSu	1082	2.24	3.79	−17	−69.2	−1.6	−3.45
85	All	9308	2.26	4.86	−242	−115.0	−2.6	−16.88
	SkilTech	3054	2.13	4.19	−63	−96.7	−2.1	−7.88
	ElMeRepa	3232	2.14	4.80	−86	−124.3	−2.7	−10.45
	Support	1822	2.56	5.49	−53	−114.5	−2.9	−7.92
	CrfSerSu	1168	2.39	5.82	−40	−143.5	−3.4	−7.67

Table 2.19

SECOND-TERM ATTRITION LOSSES BY BONUS

FY	Bonus	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	7117	1.98	2.61	–45	–31.8	–0.6	–3.82
	None	4198	2.19	2.26	–3	–3.2	–0.1	–0.31
	1	2201	1.74	2.42	–15	–39.1	–0.7	–2.44
84	All	8702	2.07	3.92	–161	–89.4	–1.9	–12.12
	None	5584	2.19	4.01	–102	–83.1	–1.8	–9.29
	1	2263	1.83	3.14	–30	–71.6	–1.3	–4.65
85	All	9308	2.26	4.86	–242	–115.0	–2.6	–16.88
	None	5749	2.44	5.27	–163	–116.0	–2.8	–13.91
	1	1881	2.34	4.63	–43	–97.9	–2.3	–6.57

Table 2.20

SECOND-TERM ATTRITION LOSSES BY GRADE

FY	Grade	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	7117	1.98	2.61	–45	–31.8	–0.6	–3.82
	E-4	3690	2.56	2.49	3	2.7	0.1	0.27
	E-5	2935	1.46	1.67	–6	–14.4	–0.2	–0.95
84	All	8702	2.07	3.92	–161	–89.4	–1.9	–12.12
	E-4	4885	2.54	3.91	–67	–53.9	–1.4	–6.09
	E-5	3351	1.53	2.21	–23	–44.4	–0.7	–3.21
85	All	9308	2.26	4.86	–242	–115.0	–2.6	–16.88
	E-4	4965	2.82	5.24	–120	–85.8	–2.4	–10.30
	E-5	6762	1.74	2.45	–48	–40.8	–0.7	–4.47

Table 2.21

SECOND-TERM ATTRITION LOSSES BY TERM OF ENLISTMENT

FY	TOE	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	7117	1.98	2.61	−45	−31.8	−0.6	−3.82
	4	4639	2.03	2.61	−27	−28.6	−0.6	−2.80
	6	2294	1.97	2.66	−16	−35.0	−0.7	−2.38
84	All	8702	2.07	3.92	−161	−89.4	−1.9	−12.12
	4	5126	2.11	4.31	−113	−104.3	−2.2	−10.96
	6	3320	2.07	3.31	−41	−59.9	−1.2	−5.02
85	All	9308	2.26	4.86	−242	−115.0	−2.6	−16.88
	4	5212	2.26	5.83	−186	−158.0	−3.6	−17.34
	6	3939	2.35	3.67	−52	−56.2	−1.3	−5.47

Loss Rates

The second-term ETS model[10] applied to some 1,200–1,400 airmen in the three fiscal years studied, or about 3 percent of the sample. The performance of this model is examined with respect to CFG (Table 2.22), bonus (Table 2.23), and grade (Table 2.24).

Generally, the model performance is fair in FY 83 and FY 84, and a little worse but not terrible in FY 85. It tracks differences in CFGs and grade fairly well. Actual loss rates increased sharply in FY 85, and the predicted loss rates followed, although the gap between predicted and actual loss rates widened. It is comforting that the model at least changed, and if the reasons for the general overprediction seen in FY 83 could be diagnosed and repaired, the performance in FY 85 would no doubt improve substantially. In FY 85 there is a sharp decrease in loss rates for airmen offered a bonus multiple 1, while the model predicts a slight increase. Evidently a bonus multiple of 1 had little effect in the years used to estimate, but something changed in FY 85. Loss rates for airmen at grade 5 are somewhat lower than for airmen at grade 4, and the model does a good job of capturing this effect.

[10]Carter et al. (1987), Table 6.1.

Table 2.22

SECOND-TERM ETS LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1203	14.26	12.05	27	15.5	2.2	2.19
	SkilTech	434	16.06	17.51	–6	–9.0	–1.5	–0.82
	ElMeRepa	305	13.50	8.20	16	39.3	5.3	2.71
	Support	312	12.58	9.94	8	21.0	2.6	1.41
	CrfSerSu	148	13.97	8.11	9	41.9	5.9	2.06
84	All	1410	15.72	13.26	35	15.6	2.5	2.54
	SkilTech	422	17.76	19.43	–7	–9.4	–1.7	–0.90
	ElMeRepa	353	15.22	8.78	23	42.3	6.4	3.37
	Support	419	13.81	11.69	9	15.4	2.1	1.26
	CrfSerSu	207	16.31	11.59	10	28.9	4.7	1.84
85	All	1390	21.88	17.27	64	21.1	4.6	4.16
	SkilTech	481	22.91	18.50	21	19.2	4.4	2.30
	ElMeRepa	363	22.73	17.36	19	23.6	5.4	2.44
	Support	360	19.66	15.83	14	19.5	3.8	1.83
	CrfSerSu	178	21.99	16.29	10	25.9	5.7	1.84

Table 2.23

SECOND-TERM ETS LOSSES BY BONUS

FY	Bonus	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1203	14.26	12.05	27	15.5	2.2	2.19
	None	793	14.41	11.99	19	16.8	2.4	1.94
	1	317	13.51	11.99	5	11.3	1.5	0.79
84	All	1410	15.72	13.26	35	15.6	2.5	2.54
	None	1086	15.85	12.80	33	19.2	3.0	2.75
	1	266	15.18	12.41	7	18.2	2.8	1.26
85	All	1390	21.88	17.27	64	21.1	4.6	4.16
	None	1076	21.44	17.10	47	20.2	4.3	3.47
	1	205	22.68	14.63	17	35.5	8.0	2.75

Table 2.24

SECOND-TERM ETS LOSSES BY GRADE

FY	Grade	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1203	14.26	12.05	27	15.5	2.2	2.19
	E-4	223	20.26	14.35	13	29.2	5.9	2.20
	E-5	938	13.16	11.62	14	11.7	1.5	1.40
84	All	1410	15.72	13.26	35	15.6	2.5	2.54
	E-4	256	22.28	19.53	7	12.3	2.7	1.06
	E-5	1074	14.70	11.45	35	22.1	3.2	3.01
85	All	1390	21.88	17.27	64	21.1	4.6	4.16
	E-4	282	28.62	21.99	19	23.2	6.6	2.46
	E-5	1014	20.65	15.88	48	23.1	4.8	3.75

Extend-Given-Stay Rates

The second-term ETS extend-given-stay model[11] applies to about 1,300 airmen, with a loss rate of around 12 percent, hence approximately 1,100 airmen remain and are faced with the extend-given-stay decision. The performance of this model is examined with respect to Career Field Group (Table 2.25), bonus (Table 2.26), and grade (Table 2.27).

The performance of the model is not too good. Both actual and predicted extend-given-stay rates remained about the same in FY 83 and FY 84, and jumped sharply in FY 85, so at least the model appears to be responsive to change. The problem lies in the fact that the model overpredicted the rates in all three years. The error is not so severe in some smaller subgroups, but because the sample sizes are small it is not certain whether the superior performance is due to chance.

Second-Term Extension

The second-term extension model[12] applies to just over 1,000 airmen in FY 83, and even fewer in FY 84 and FY 85. The performance of this model is examined with respect to Career Field Group (Table 2.28) and decisionmaker/nondecisionmaker status (Table 2.29).

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[11] Carter et al. (1987), Table 6.2.

[12] Carter et al. (1987), Table 8.1 and Table 8.2.

Table 2.25

SECOND-TERM EXTEND-GIVEN-STAY BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Stay Rates Predicted	Stay Rates Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1058	40.94	36.11	51	11.8	4.2	3.00
	SkilTech	358	42.94	34.92	29	18.7	6.6	2.78
	ElMeRepa	280	35.94	28.57	21	20.5	6.8	2.46
	Support	281	42.84	41.28	4	3.6	1.4	0.50
	CrfSerSu	136	41.07	44.85	−5	−9.2	−3.5	−0.86
84	All	1223	41.24	36.39	59	11.8	4.2	3.21
	SkilTech	340	44.24	32.65	39	26.2	9.3	3.86
	ElMeRepa	322	35.91	32.61	11	9.2	3.0	1.18
	Support	370	41.93	40.81	4	2.7	1.0	0.41
	CrfSerSu	183	42.60	40.98	3	3.8	1.4	0.42
85	All	1150	49.75	41.22	98	17.1	7.1	5.26
	SkilTech	392	52.67	41.84	42	20.6	8.8	3.88
	ElMeRepa	300	45.23	34.33	33	24.1	9.0	3.45
	Support	303	50.54	50.50	0	0.1	0.0	0.01
	CrfSerSu	149	49.13	33.56	23	31.7	13.0	3.48

Table 2.26

SECOND-TERM EXTEND-GIVEN-STAY BY BONUS

FY	Bonus	Airmen at Risk	Stay Rates Predicted	Stay Rates Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1058	40.94	36.11	51	11.8	4.2	3.00
	None	701	45.08	41.23	27	8.5	3.4	1.93
	1	279	35.94	25.09	30	30.2	9.5	3.54
84	All	1223	41.24	36.39	59	11.8	4.2	3.21
	None	947	43.62	38.75	46	11.2	4.2	2.82
	1	233	35.04	29.18	14	16.7	5.1	1.75
85	All	1150	49.75	41.22	98	17.1	7.1	5.26
	None	892	51.84	43.83	71	15.5	6.6	4.36
	1	157	43.31	42.86	1	1.0	0.3	0.10

Table 2.27

SECOND-TERM EXTEND-GIVEN-STAY BY GRADE

FY	Grade	Airmen at Risk	Stay Rates		PE	PRE (%)	PEPNR (%)	SPE
			Predicted	Actual				
83	All	1058	40.94	36.11	51	11.8	4.2	3.00
	E-4	191	45.87	42.93	6	6.4	2.5	0.75
	E-5	561	34.62	36.30	−9	−4.9	−1.0	−0.65
84	All	1223	41.24	36.39	59	11.8	4.2	3.21
	E-4	206	47.25	44.66	5	5.5	2.1	0.67
	E-5	951	40.37	34.28	58	15.1	5.4	3.60
85	All	1150	49.75	41.22	98	17.1	7.1	5.26
	E-4	220	54.79	48.18	15	12.1	5.2	1.74
	E-5	853	48.84	38.69	87	20.8	8.5	5.44

Table 2.28

SECOND-TERM EXTENSION LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%)		PE	PRE (%)	PEPNR (%)	SPE
			Predicted	Actual				
83	All	1037	14.71	14.27	5	3.0	0.4	0.40
	SkilTech	409	16.47	14.43	8	12.4	2.0	1.11
	ElMeRepa	246	14.51	15.45	−2	−6.5	−0.9	−0.42
	Support	254	11.84	12.20	−1	−3.0	−0.4	−0.18
	CrfSerSu	118	14.94	16.10	−1	−7.8	−1.2	−0.35
84	All	759	14.92	14.10	6	5.5	0.8	0.63
	SkilTech	272	17.73	18.75	−3	−5.8	−1.0	−0.44
	ElMeRepa	157	13.26	12.74	1	3.9	0.5	0.19
	Support	230	13.55	13.48	0	0.5	0.1	0.03
	CrfSerSu	97	13.45	5.15	8	61.7	8.3	2.40
85	All	736	19.09	14.67	33	23.2	4.4	3.05
	SkilTech	225	21.88	18.22	8	16.7	3.7	1.33
	ElMeRepa	158	19.13	11.39	12	40.5	7.7	2.47
	Support	234	16.47	11.97	11	27.3	4.5	1.86
	CrfSerSu	117	18.45	17.95	1	2.7	0.5	0.14

The model does a very good job in FY 83, with a standardized prediction error well within the expected range. It does nearly as well in FY 84, but in FY 85 a sharp increase in predicted loss rates is not matched by what really happened. Unlike first-term

extenders, the fraction in the "decisionmaker" category remained about the same between FY 83 and FY 85. There was a slight increase in the loss rate among decisionmakers in FY 85, and a corresponding, but much larger, increase in the predicted loss rate. The error seen in FY 85 can be attributed largely to this overprediction.

Career Attrition

The career attrition model[13] applies to between 9,000 and 10,000 airmen, or about 20 percent of the sample. The performance of the model is examined with respect to term year (Table 2.30), Career Field Group (Table 2.31), bonus (Table 2.32), grade (Table 2.33), and term of enlistment (Table 2.34).

This model substantially underpredicts the actual loss rates. It does so in FY 83, a year used to estimate it, and by an even greater fraction in FY 85. Actual loss rates are low, however, so when the error is calculated as a percent of the number of airmen at risk, this error is very low. Thus, the indifferent performance of this model may not affect estimates of total losses when they are combined with those of other models.

Table 2.29

SECOND-TERM EXTENSION LOSSES BY ATTRITION/DECISIONMAKER

FY	Attrition /Decision	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1037	14.71	14.27	5	3.0	0.4	0.40
	Attrition	488	3.51	1.84	8	47.6	1.7	2.00
	Decision	549	24.66	25.32	–4	–2.7	–0.7	–0.36
84	All	759	14.92	14.10	6	5.5	0.8	0.63
	Attrition	382	3.47	2.62	3	24.5	0.9	0.91
	Decision	377	26.53	25.73	3	3.0	0.8	0.35
85	All	736	19.09	14.67	33	23.2	4.4	3.05
	Attrition	382	3.44	2.62	3	23.8	0.8	0.88
	Decision	354	35.98	27.68	29	23.1	8.3	3.25

[13]Carter et al. (1987), Table 4.3.

Table 2.30

CAREER ATTRITION LOSSES BY TERM YEAR

FY	Term Year	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	9169	0.68	1.06	−35	−55.9	−0.4	−4.43
	1	3167	0.46	0.85	−12	−84.8	−0.4	−3.24
	2	2908	0.72	1.10	−11	−52.8	−0.4	−2.42
	3	2507	0.85	1.08	−6	−27.1	−0.2	−1.25
84	All	9631	0.67	1.09	−40	−62.7	−0.4	−5.05
	1	3243	0.46	0.74	−9	−60.9	−0.3	−2.36
	2	3025	0.70	1.32	−19	−88.6	−0.6	−4.09
	3	2733	0.83	1.28	−12	−54.2	−0.5	−2.59
85	All	9910	0.70	1.49	−78	−112.9	−0.8	−9.43
	1	2852	0.43	0.98	−16	−127.9	−0.6	−4.49
	2	3115	0.73	2.02	−40	−176.7	−1.3	−8.46
	3	2843	0.83	1.55	−20	−86.7	−0.7	−4.23

Table 2.31

CAREER ATTRITION LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	9169	0.68	1.06	−35	−55.9	−0.4	−4.43
	SkilTech	2857	0.62	0.95	−9	−53.2	−0.3	−2.25
	ElMeRepa	2868	0.54	0.84	−9	−55.6	−0.3	−2.19
	Support	2303	0.80	1.13	−8	−41.2	−0.3	−1.78
	CrfSerSu	1089	0.93	1.65	−8	−77.4	−0.7	−2.48
84	All	9631	0.67	1.09	−40	−62.7	−0.4	−5.05
	SkilTech	3081	0.63	1.30	−21	−106.3	−0.7	−4.70
	ElMeRepa	2963	0.54	0.71	−5	−31.5	−0.2	−1.26
	Support	2416	0.77	1.41	−15	−83.1	−0.6	−3.60
	CrfSerSu	1126	0.91	0.89	0	2.2	0.0	0.07
85	All	9910	0.70	1.49	−78	−112.9	−0.8	−9.43
	SkilTech	3085	0.67	1.17	−15	−74.6	−0.5	−3.40
	ElMeRepa	3098	0.58	1.32	−23	−127.6	−0.7	−5.42
	Support	2420	0.78	1.78	−24	−128.2	−1.0	−5.59
	CrfSerSu	1268	0.92	1.89	−12	−105.4	−1.0	−3.62

Table 2.32

CAREER ATTRITION LOSSES BY BONUS

FY	Bonus	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	9169	0.68	1.06	−35	−55.9	−0.4	−4.43
	None	8520	0.66	0.93	−23	−40.9	−0.3	−3.08
	1	540	0.87	1.67	−4	−92.0	−0.8	−2.00
84	All	9631	0.67	1.09	−40	−62.7	−0.4	−5.05
	None	8975	0.66	0.94	−25	−42.4	−0.3	−3.28
	1	520	0.81	2.31	−8	−185.2	−1.5	−3.82
85	All	9910	0.70	1.49	−78	−112.9	−0.8	−9.43
	None	8556	0.71	1.48	−66	−108.5	−0.8	−8.48
	1	408	1.17	2.45	−5	−109.4	−1.3	−2.40

Table 2.33

CAREER ATTRITION LOSSES BY GRADE

FY	Grade	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	9169	0.68	1.06	−35	−55.9	−0.4	−4.43
	E-5	4233	0.92	1.20	−12	−30.4	−0.3	−1.91
	E-6	3355	0.39	0.60	−7	−53.8	−0.2	−1.95
	E-7	1203	0.34	0.08	3	76.5	0.3	1.55
84	All	9631	0.67	1.09	−40	−62.7	−0.4	−5.05
	E-5	4360	0.90	1.12	−10	−24.4	−0.2	−1.54
	E-6	3511	0.39	0.43	−1	−10.3	−0.0	−0.38
	E-7	1334	0.34	0.37	−0	−8.8	−0.0	−0.19
85	All	9910	0.70	1.49	−78	−112.9	−0.8	−9.43
	E-5	4279	0.98	1.73	−32	−76.5	−0.8	−4.98
	E-6	3697	0.42	0.41	0	2.4	0.0	0.09
	E-7	1477	0.35	0.20	2	42.9	0.1	0.98

Table 2.34

CAREER ATTRITION LOSSES BY TERM OF ENLISTMENT

FY	TOE	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	9169	0.68	1.06	−35	−55.9	−0.4	−4.43
	4	5562	0.72	1.10	−21	−52.8	−0.4	−3.35
	6	2476	0.67	1.13	−11	−68.7	−0.5	−2.81
84	All	9631	0.67	1.09	−40	−62.7	−0.4	−5.05
	4	5095	0.39	0.90	−26	−130.8	−0.5	−5.84
	6	3310	0.70	1.42	−24	−102.9	−0.7	−4.97
85	All	9910	0.70	1.49	−78	−112.9	−0.8	−9.43
	4	4814	0.69	1.58	−43	−129.0	−0.9	−7.46
	6	3843	0.78	1.29	−20	−65.4	−0.5	−3.59

Career ETS

The career ETS model has two parts. One part calculates loss rates; the other, extend-given-stay rates.

Loss Rates. The career ETS model[14] applies to about 1,600 airmen in the sample, about 3 percent of the entire sample. Its performance is examined with respect to Career Field Group (Table 2.35) and grade (Table 2.36).

Generally, the model does quite well in each of the three fiscal years and among the strata considered here. Even in FY 85, two years beyond the last year used to estimate the model, the standardized prediction error remains well within acceptable limits.

The tables show rather high relative errors because the actual number of losses is extremely low (sometimes only five or six airmen). This is no cause for concern, because the other error measures, better indicators of validity, show the model is performing accurately.

Extend-Given-Stay Rates. The career ETS model applies to around 1,600 airmen, with a loss rate of less than 2 percent. Hence, approximately 1,600 airmen are faced with the "extend-given-stay" decision. The performance of this model[15] is examined with respect to Career Field Group (Table 2.37) and grade (Table 2.38).

[14] Carter et al. (1987), Table 7.5.
[15] Carter et al. (1987), Table 7.1.

Table 2.35

CAREER ETS LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1617	1.76	1.67	1	5.1	0.1	0.28
	SkilTech	501	2.30	1.80	3	21.7	0.5	0.75
	ElMeRepa	450	1.52	0.67	4	55.9	0.8	1.47
	Support	466	1.48	1.93	–2	–30.4	–0.5	–0.80
	CrfSerSu	190	1.65	3.16	–3	–91.5	–1.5	–1.63
84	All	1741	2.16	2.35	–3	–8.8	–0.2	–0.55
	SkilTech	476	2.85	2.52	2	11.6	0.3	0.43
	ElMeRepa	532	1.74	2.26	–3	–29.9	–0.5	–0.92
	Support	481	1.80	1.46	2	18.9	0.3	0.56
	CrfSerSu	246	1.91	4.07	–5	–113.1	–2.2	–2.48
85	All	1639	2.55	2.93	–6	–14.9	–0.4	–0.98
	SkilTech	465	2.91	1.94	5	33.3	1.0	1.24
	ElMeRepa	474	2.44	3.59	–5	–47.1	–1.2	–1.62
	Support	488	2.31	3.07	–4	–32.9	–0.8	–1.12
	CrfSerSu	201	2.56	2.99	–1	–16.8	–0.4	–0.39

Table 2.36

CAREER ETS LOSSES BY GRADE

FY	Grade	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1617	1.76	1.67	1	5.1	0.1	0.28
	E-5	601	3.62	3.33	2	8.0	0.3	0.38
	E-6	760	0.75	0.53	2	29.3	0.2	0.70
	E-7	231	0.32	0.87	–1	–171.9	–0.6	–1.48
84	All	1741	2.16	2.35	–3	–8.8	–0.2	–0.55
	E-5	600	4.19	4.00	1	4.5	0.2	0.23
	E-6	859	0.98	1.05	–1	–7.1	–0.1	–0.21
	E-7	250	0.38	0.80	–1	–110.5	–0.4	–1.08
85	All	1639	2.55	2.93	–6	–14.9	–0.4	–0.98
	E-5	567	4.82	4.59	1	4.8	0.2	0.26
	E-6	751	1.41	1.33	1	5.7	0.1	0.19
	E-7	271	0.52	0.37	0	28.8	0.2	0.34

Table 2.37

CAREER EXTEND-GIVEN-STAY BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Stay Rates Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1590	22.50	28.99	-103	-28.8	-6.4	-6.15
	SkilTech	492	22.51	29.47	-34	-30.9	-6.8	-3.66
	ElMeRepa	447	21.61	28.64	-31	-32.5	-7.0	-3.60
	Support	457	23.14	31.07	-36	-34.3	-7.8	-3.98
	CrfSerSu	184	23.18	22.83	1	1.5	0.3	0.11
84	All	1700	21.93	28.53	-112	-30.1	-6.4	-6.50
	SkilTech	464	22.61	30.17	-35	-33.4	-7.4	-3.84
	ElMeRepa	520	21.64	24.23	-13	-12.0	-2.5	-1.42
	Support	474	22.05	33.97	-56	-54.1	-11.7	-6.21
	CrfSerSu	236	20.91	23.31	-6	-11.5	-2.3	-0.89
85	All	1591	21.70	29.16	-119	-34.4	-7.2	-7.11
	SkilTech	465	22.13	29.82	-36	-34.7	-7.5	-3.95
	ElMeRepa	457	21.86	27.27	-25	-24.7	-5.2	-2.75
	Support	473	20.87	28.12	-34	-34.7	-7.0	-3.82
	CrfSerSu	195	22.15	33.33	-22	-50.5	-10.8	-3.70

Table 2.38

CAREER EXTEND-GIVEN-STAY BY GRADE

FY	Grade	Airmen at Risk	Stay Rates Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	1590	22.50	28.99	-103	-28.8	-6.4	-6.15
	E-5	581	23.32	29.09	-34	-24.7	-5.6	-3.23
	E-6	756	21.74	28.70	-53	-32.0	-6.9	-4.63
84	All	1700	21.93	28.53	-112	-30.1	-6.4	-6.50
	E-5	576	22.52	30.21	-44	-34.1	-7.4	-4.33
	E-6	850	21.10	27.65	-56	-31.0	-6.5	-4.66
85	All	1591	21.70	29.16	-119	-34.4	-7.2	-7.11
	E-5	541	22.47	30.50	-43	-35.7	-7.7	-4.37
	E-6	741	20.77	29.96	-68	-44.2	-9.1	-6.13

Both predicted and actual rates remained about the same from one year to the next, with predictions falling substantially below the actual rates. The underprediction is about the same in all subgroups. The fact that the standardized prediction error is lower in some groups simply reflects the fact that the sample size is smaller.

Career Extension

The career extension model[16] applies to fewer than 1,000 airmen, less than 2 percent of the sample. Its performance is considered by Career Field Group (Table 2.39), grade (Table 2.40), and the decision/nondecision state (Table 2.41).

This model does well in each of the three fiscal years, and within most of the strata considered. As in the career ETS model, some relative errors are high because of the small number of actual losses represented, and this is no cause for concern.

As in the previous extension models, the loss rate among decisionmakers was somewhat higher in FY 85 than in FY 83. The career model matched this increase very closely, predicting virtually the same number of losses.

Table 2.39

CAREER EXTENSION LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	829	3.77	4.34	−5	−15.1	−0.6	−0.86
	SkilTech	267	4.10	3.37	2	17.8	0.7	0.60
	ElMeRepa	233	3.01	3.86	−2	−28.2	−0.9	−0.76
	Support	232	3.19	6.47	−8	−102.8	−3.3	−2.84
	CrfSerSu	92	6.34	3.26	3	48.6	3.1	1.21
84	All	690	4.10	2.90	8	29.3	1.2	1.59
	SkilTech	218	4.65	3.67	2	21.1	1.0	0.69
	ElMeRepa	185	2.88	1.08	3	62.5	1.8	1.46
	Support	205	3.60	3.41	0	5.3	0.2	0.15
	CrfSerSu	76	6.89	3.95	2	42.7	2.9	1.01
85	All	679	4.67	5.15	−3	−10.3	−0.5	−0.59
	SkilTech	199	5.37	7.54	−4	−40.4	−2.2	−1.36
	ElMeRepa	185	3.40	2.16	2	36.5	1.2	0.93
	Support	219	4.08	5.02	−2	−23.0	−0.9	−0.70
	CrfSerSu	70	8.01	5.71	2	28.7	2.3	0.71

[16]Carter et al. (1987), Table 8.1 and Table 8.2.

Table 2.40

CAREER EXTENSION LOSSES BY GRADE

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	829	3.77	4.34	−5	−15.1	−0.6	−0.86
	E-5	286	4.17	7.69	−10	−84.4	−3.5	−2.98
	E-6	390	3.58	2.31	5	35.5	1.3	1.35
84	All	690	4.10	2.90	8	29.3	1.2	1.59
	E-5	187	4.39	4.81	−1	−9.6	−0.4	−0.28
	E-6	345	4.04	2.03	7	49.8	2.0	1.90
85	All	679	4.67	5.15	−3	−10.3	−0.5	−0.59
	E-5	198	5.17	8.08	−6	−56.3	−2.9	−1.85
	E-6	320	4.72	4.37	1	7.4	0.3	0.30

Table 2.41

CAREER EXTENSION LOSSES BY ATTRITION/DECISIONMAKER

FY	Attrition /Decision	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	829	3.77	4.34	−5	−15.1	−0.6	−0.86
	Attrition	451	1.34	1.55	−1	−15.7	−0.2	−0.39
	Decision	378	6.66	7.67	−4	−15.2	−1.0	−0.79
84	All	690	4.10	2.90	8	29.3	1.2	1.59
	Attrition	373	1.33	0.27	4	79.7	1.1	1.79
	Decision	317	7.35	5.99	4	18.5	1.4	0.93
85	All	679	4.67	5.15	−3	−10.3	−0.5	−0.59
	Attrition	406	1.34	2.22	−4	−65.7	−0.9	−1.54
	Decision	273	9.62	9.52	0	1.0	0.1	0.06

Retirement

The retirement model[17] applies to about 3,300 airmen each fiscal year, 6 percent of the sample. Its performance is examined with respect to Career Field Group (Table 2.42), grade (Table 2.43), and term year (Table 2.44).

This model's performance is quite good. Overall, it does better in FY 84 and FY 85 than it did in FY 83. The standardized prediction error is usually within the expected range.

[17]Carter et al. (1987), Table 9.3.

Table 2.42

RETIREMENT LOSSES BY CAREER FIELD GROUP

FY	Career Field Group	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	3421	25.78	27.27	−51	−5.8	−1.5	−1.99
	SkilTech	1207	25.58	25.60	−0	−0.1	−0.0	−0.02
	ElMeRepa	858	27.48	29.60	−18	−7.7	−2.1	−1.39
	Support	989	24.29	26.29	−20	−8.2	−2.0	−1.47
	CrfSerSu	348	26.57	30.17	−13	−13.5	−3.6	−1.52
84	All	3360	24.51	24.40	4	0.4	0.1	0.15
	SkilTech	1209	24.57	26.22	−20	−6.7	−1.6	−1.33
	ElMeRepa	878	25.76	19.93	51	22.6	5.8	3.95
	Support	922	22.88	25.49	−24	−11.4	−2.6	−1.89
	CrfSerSu	325	25.67	26.77	−4	−4.3	−1.1	−0.45
85	All	3315	27.76	28.02	−9	−0.9	−0.3	−0.33
	SkilTech	1203	28.09	30.42	−28	−8.3	−2.3	−1.80
	ElMeRepa	887	29.25	27.51	15	5.9	1.7	1.14
	Support	885	25.30	25.20	1	0.4	0.1	0.07
	CrfSerSu	315	29.09	28.25	3	2.9	0.8	0.33

Table 2.43

RETIREMENT LOSSES BY GRADE

FY	Grade	Airmen at Risk	Loss Rates (%) Predicted	Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	3421	25.78	27.27	−51	−5.8	−1.5	−1.99
	E-6	587	33.25	34.07	−5	−2.5	−0.8	−0.42
	E-7	1641	25.82	27.36	−25	−6.0	−1.5	−1.43
	E-8	761	20.24	22.21	−15	−9.7	−2.0	−1.35
84	All	3360	24.51	24.40	4	0.4	0.1	0.15
	E-6	523	33.93	33.46	2	1.4	0.5	0.23
	E-7	1642	24.63	24.67	−1	−0.2	−0.0	−0.04
	E-8	755	18.10	16.16	15	10.7	1.9	1.38
85	All	3315	27.76	28.02	−9	−0.9	−0.3	−0.33
	E-6	511	37.37	35.62	9	4.7	1.7	0.82
	E-7	1631	27.12	29.31	−36	−8.1	−2.2	−1.99
	E-8	733	21.66	19.37	17	10.6	2.3	1.51

Table 2.44

RETIREMENT LOSSES BY TERM YEAR

FY	Term Year	Airmen at Risk	Loss Rates (%) Predicted	Loss Rates (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
83	All	3421	25.78	27.27	−51	−5.8	−1.5	−1.99
	1	520	17.30	22.69	−28	−31.2	−5.4	−3.25
	2	641	21.51	19.81	11	7.9	1.7	1.05
	3	577	29.62	24.61	29	16.9	5.0	2.64
	4	734	28.58	25.61	22	10.4	3.0	1.78
	5	497	24.79	37.02	−61	−49.3	−12.2	−6.31
84	All	3360	24.51	24.40	4	0.4	0.1	0.15
	1	504	17.01	17.06	−0	−0.3	−0.0	−0.03
	2	594	19.86	18.18	10	8.5	1.7	1.03
	3	610	25.79	20.33	33	21.2	5.5	3.08
	4	817	27.38	26.32	9	3.9	1.1	0.68
	5	418	25.52	34.21	−36	−34.1	−8.7	−4.08
85	All	3315	27.76	28.02	−9	−0.9	−0.3	−0.33
	1	527	20.39	22.39	−11	−9.8	−2.0	−1.14
	2	613	24.18	20.55	22	15.0	3.6	2.10
	3	579	29.39	26.42	17	10.1	3.0	1.57
	4	740	30.85	29.05	13	5.8	1.8	1.06
	5	472	27.57	35.17	−36	−27.6	−7.6	−3.69

III. FISCAL YEAR TEST AND EVALUATION

INTRODUCTION

This section discusses the fiscal year test and evaluation of the middle-term disaggregate loss models. These models, described by Carter et al. (1987), estimate loss rates for an airman's year at risk.[1] Such loss rates by themselves are not particularly useful. Planners need to predict loss rates for a fiscal year, and a fiscal year coincides with the year at risk for only a small fraction of the Air Force. The process of combining the disaggregate loss models to obtain fiscal year loss rates is called *blending*.[2]

Once the blending process was formulated and coded, the combined models were used to estimate loss rates over a fiscal year and these rates were compared with the ones actually observed. This comparison is called the *fiscal year evaluation.*

BLENDING

Assume that we wish to produce blended loss rates for fiscal year 1984 (FY 84). Of course, the discussion applies generally to any other fiscal year with obvious changes. This fiscal year test and evaluation covers only FY 84, because that was the only fiscal year when data not used for estimation were available at the time of the evaluation.

Consider the following example: At the beginning of FY 84 an airman is selected and found to be five months into the ETS year of his first term. To calculate the probability that he will be lost sometime during FY 84, it is a bit easier to think about the probability he will *survive* the fiscal year. What is the probability he will still be in the service at the end of FY 84? To calculate this survival probability, it is necessary to estimate:

1. The probability he will survive for the remaining seven months of his original ETS year.

[1]See Sec. II for a definition of year at risk.

[2]A different approach to blending is used here from the approach being used to prepare fiscal year loss and extension rates as input to the EFMS's Middle-Term Disaggregate IPM.

2. The probability he will reenlist, and the probability he will survive the first five months of his next term if he does reenlist.
3. The probability he will extend, and the probability he will survive the first five months of his extension if he does extend.

Blending has two aspects that need to be addressed:

1. More than one year at risk and more than one loss model for each airman need to be considered.
2. Loss rates must be calculated for *parts* of a year at risk.

Multiple Years at Risk and Loss Models

The year at risk, that applies to an airman when he is selected at the beginning of FY 84 is his *beginning year at risk.* The cohort loss model that applies to him at that point is his *beginning model.*

During the remainder of his beginning year at risk, an airman may leave the service. If he does not, then depending on his beginning status (ETS, extension, etc.), he will either reenlist, extend, or simply remain in his current term. Which of these "choices" is available depends on the beginning model. If the beginning model is an ETS model, then the airman can reenlist or extend, but he cannot remain. If the beginning model is an attrition model, then he cannot extend, he can only remain.[3] Thus, extending and remaining are disjoint choices—an airman never faces both of them at one time. The definition of "extending" will therefore be broadened to mean "remaining." An airman who begins in an attrition model and remains in the service for another year will be said to have *extended.*

As the beginning year at risk covered the beginning of the fiscal year, so the *ending year at risk* covers the end. Two models are needed for the ending year at risk. An airman who does not leave faces two choices—to reenlist or to extend.[4] If he chooses to reenlist, the loss model used to calculate the loss probability for the ending year at risk

[3]In the present implementation of the models, he cannot reenlist either, although in fact it is sometimes possible to do so.

[4]Although airmen on attrition status cannot reenlist, reenlistment will be regarded here as a choice that can be made with probability zero. A future implementation of these models can easily change this assumption.

will be denoted the *reenlisting model.* If he chooses to extend (and sometimes that is the only choice he can make), the corresponding loss model will be called the *extending model.* Collectively these two models are the *ending models*. Figure 2 displays the relationship between beginning, extending, and reenlisting years at risk. A "triple" airman record helps address this complicated situation.

Loss Rates for Parts of Years

Whatever the beginning model is, it will rarely coincide with the fiscal year. As illustrated in Fig. 3, it will generally be necessary to calculate a loss rate for some risk interval, the *beginning risk interval*, that is less than a year and will fall at the end of some year at risk. Similarly, whatever the ending models are, they will never coincide with the fiscal year, and it will be necessary to calculate loss rates over some interval of time less than a year, the *ending risk interval*. It is illustrated in Fig. 4.

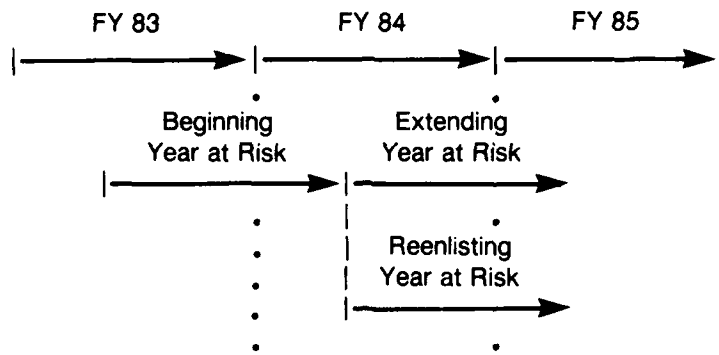

Fig. 2—Relationship Between Fiscal Years and Cohort Years

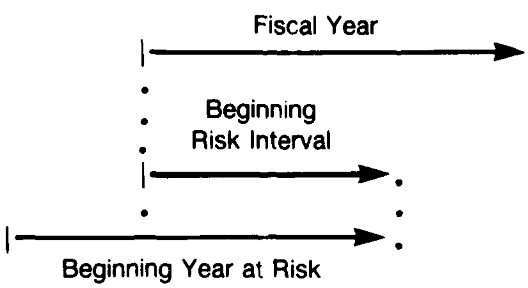

Fig. 3—Illustration of Beginning Risk Interval

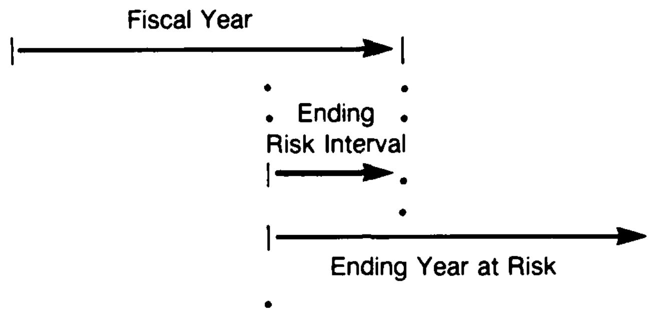

Fig. 4—Illustration of Ending Risk Interval

These data suggest that for any year at risk, the beginning of the next fiscal year is just as likely to occur in the first month of the year at risk as in any other month. Thus, the event "fiscal year begins" is uniformly distributed over the months of any year at risk. The same cannot be said of losses, reenlistments, or extensions.

In ETS years, losses are heavily, but not exclusively, concentrated at the end of the year at risk, while reenlistments are more evenly spread. In the first term reenlistments appear to be more likely in the early part of the year than later, at least in FY 84. In the YAR file, ETS extensions always occur at the end of a year at risk (by definition). In attrition years, losses are spread somewhat smoothly over the year but in the first year of the first term are more frequent in the early part than later. The temporal distribution of losses for extension terms is the most complicated of all, and not well understood. For example, losses for airmen in the second year of a two-year extension are somewhat concentrated at the end of that year, but many occur earlier, bunching up at three months, six months, and nine months beyond the beginning of the year at risk. Reenlistments out of extension status can occur anytime.

The temporal nonuniformity of losses and reenlistments over time poses several problems for blending. First, it causes a sampling problem. Because losses, reenlistments, and extensions are distributed over time in different ways, the sample of airmen whose year at risk covers the beginning of some fiscal year will have a different composition from the subsample who were actually still in the service when that fiscal year began. For instance, if reenlistments occur anytime but losses are concentrated at the end of the year at risk, the subsample of airmen still in the service at the beginning of the fiscal year will have proportionally fewer reenlistees than the full sample that

includes the airmen who left before the fiscal year began. Second, the nonuniformity means it is necessary to figure out ways of adjusting the year-at-risk loss rates, which are annual rates, to get loss rates for parts of a year.

The Blending Process[5]

This section describes the computational process used to calculate blended, fiscal year loss probabilities for use in the test and evaluation of the middle-term disaggregate loss models.

The process is somewhat complex, and comprises five steps:

Step 1: Triple. Read data from the YAR file, and create three records for every one that covers the beginning of the fiscal year: a beginning record, an extending record, and a reenlisting record.

Step 2: Model. Use the cohort models to calculate year-at-risk loss rates for each record in the triple file.

Step 3: Merge. Merge these loss rates by airman.

Step 4: Blend. For each airman, calculate a fiscal year loss rate.

Step 5: Compare. Read the YAR file again, selecting records for the *next* fiscal year, and compare with predictions.

Step 1: Triple. Recall from the previous section that in order to calculate fiscal year loss probabilities, as many as three different cohort loss models may be needed. Linking the code that describes the different loss models to create a single "fiscal year loss rate model" turned out to be inconvenient because the original code was written in the SAS language, which is not useful for complex programs. Instead, the code written to do the cohort loss evaluation is retained as it stands, and the estimates combined. Furthermore, using the same code makes it unnecessary to write anything new, leaving less room for error, because the cohort loss evaluation established that the code works correctly.

Section II, to test one of the cohort loss models, passed a sample of year-at-risk records through the model. Each model had a section that allowed it to recognize which records it was supposed to use and which records it was supposed to ignore. For

[5]Alternative solutions to blending problems are used in the program that creates the fiscal year loss and extension rate inputs for the Middle-Term Disaggregate IPM.

example, to test the first-term ETS model for FY 84, a 10 percent sample of records from the YAR file for FY 84 was passed through the first-term ETS model. That model selected out the first-term ETS records and calculated actual and estimated losses. It ignored the other records.

For fiscal-year evaluation, the triple step creates a file that looks (to the cohort loss models) just like a YAR file. The main difference is that for a given sample of airmen (e.g., a 10 percent sample of airmen present at the beginning of FY 84), the triple file has three times as many records as would be used to do cohort evaluation. For each airman in the original sample, the triple file has a *beginning record* describing the airman for his beginning model, an *extending record* describing him for his extending model, and a *reenlisting record* describing him for his reenlisting model.

Specific decisions made at the triple step are:

- What sampled airmen are "present" at the beginning of the fiscal year?
- What variables should be changed for the extending models, and how should they be changed?

Who's There? In cohort evaluation, a record from the YAR file was selected if it "covered" the beginning of a particular fiscal year. However, as explained in Sec. II, a year at risk lasts a year, no matter how long an airman lasts. So for a fraction of selected records, the airman may have already left the service or may have already reenlisted for another term at the beginning of the covered fiscal year. Consequently, the triple step accepts all those records from the YAR file for which the airman is still serving the selected term at the beginning of the fiscal year.

Airmen facing an ETS decision may have left the service or reenlisted in a new term before the beginning of the covered fiscal year because of an "early out" offer. In the YAR file, such airmen will not be coded as "present" at the beginning of the fiscal year. However, to be consistent with the practice used to evaluate the ALPS file (see Sec. IV), the triple step accepts such airmen records for evaluation. (A corresponding deletion is made at the "compare step," described below.)

Updating Variables for Subsequent Models. In creating three records in the triple file from the one found in the YAR file, some data elements remain the same in all three records, and some change. No data element changes in the beginning record, of

course; that record is written out on the triple file just as it is found on the YAR file. Some data elements never change—those describing the airman's race, his age when he joined the service, etc. Some data elements are *assumed* never to change, although they might—the airman's marital status, for example. Some data elements certainly change, such as the number of years of service (incremented by 1 for both ending models), and the airman's term year (incremented for an extending model, set to 1 for a reenlisting model). Finally, one class of data elements requires assumptions as to the changes, such as the airman's grade and AFSC.

Some variables are changed in the same way for both ending models. In ending models, whether extending or reenlisting, the airman has spent one more year, and one year is added to the year of service variable (YYOS12) and the years in the military variable (STAFYR). We add 12 months to two time-in-grade variables (S1TG and STIG). (Implicit in this addition is the assumption of no change in grade.) The beginning of the year at risk is increased by one year.

Some variables are changed in a particular way for the extending model. Some of the changes depend on the beginning model, but in every case the term year is increased by one year.

If the beginning model is the first-term attrition model, the required records in the YAR file are typically missing the bonus coefficient and the AFSC variable. A zero coefficient was imputed to the first, and if the AFSC was missing, the code "99000" was assigned, the modal value for second-year, first-term airmen, and whose loss coefficient is close to the average over all the loss coefficients. No first-term airman has a cross-bonus variable WBONC (these are assigned *only* to first-term ETS airmen), so a value of zero was imputed for this variable. In the present implementation some of these imputations were not used. If an airman begins a fiscal year in an attrition year at risk, but ends up that fiscal year in an ETS year at risk, that ETS decision will not take place until the *next* fiscal year. The present implementation does not use the ETS loss calculation for a subsequent year at risk, only for a beginning year at risk. Instead, an attrition loss is calculated using another model; see "ending survival rates" below.

If the beginning model is an ETS model, then the extending model will be a true extension model, and it is necessary to decide whether the airman will extend for one year or two years. No modeling has been done on this decision, so for the purposes of test and evaluation, the fraction of all extenders in their first year who were signed up for

a two-year extension were calculated and assigned one- and two-year extensions to airmen randomly in proportion to this fraction.

Finally, some variables were changed in a particular way only for reenlisting models. All reenlistments were assumed to be for four-year terms (by setting TXTOE=4) and the term year (YNTYR) changed to 1.

Step 2: Model. During the model step the triple file is simply passed through each of the cohort loss models in almost exactly the same way as for cohort evaluation. The main difference is that different output files are created. During the evaluation, the models created tables describing performance; during blending, the models create files containing estimated loss (and extend-given-stay) rates and an airman identifier, which are used as input to the next stage.

Step 3: Merge. The model step described above creates 10 files, one for each of the 10 cohort loss models. Any particular airman will have three records among these 10 files (not necessarily all different—the beginning and extending models may be the same for some airmen). The merge step simply reassembles the three records by airman, so the resulting file contains one record per airman, and each record contains three sets of loss rates, one for the airman's beginning model, one for his extending model, and one for his reenlisting model.

Step 4: Blend. What follows is complicated. For each airman, the blending step uses a cohort loss rate for the year at risk that covers the beginning of the fiscal year, and two cohort loss rates for the year at risk that covers the end: one rate if the airman reenlists, another if he extends. It also uses the beginning model's extend-given-stay rate. It converts the cohort loss rates into survival rates for the beginning and ending risk intervals and then "blends" them into a survival rate for the fiscal year, with the following formula:

SURVIVE_FY = SURVIVE_BEG * (XGS*SURVIVE_EXT + (1-XGS)*SURVIVE_REN)

where

SURVIVE_FY	=	Fiscal year survival rate
SURVIVE_BEG	=	Survival rate for the beginning risk interval
XGS	=	Probability of extending given stay
SURVIVE_EXT	=	Survival rate for ending risk interval if airman extends
SURVIVE_REN	=	Survival rate for ending risk interval if airman reenlists

Conversion from cohort loss rates to risk interval survival rates constitutes the most difficult problem, for several reasons.

Solving the "Part-of-Year" Problem. For a given airman at the start of a fiscal year, the year at risk covering that start usually commenced several months earlier, so only part of a year remains. Thus, it is necessary to calculate the probability the airman survives the last part of a year at risk, given he survived the first part.

Similarly, the beginning year at risk generally ends several months before the fiscal year ends. Using the two cohort models that fill the gap one if the airman reenlists, the other if he does not), it is necessary to calculate a survival rate only for the first part of a year at risk: from the beginning of the new year at risk to the end of the old fiscal year.

The cohort loss models calculate annual loss rates. The timing of these events over the year is by no means simple. For example:

- Losses for first-year airmen are more heavily concentrated at the end of basic military training.
- A substantial fraction of ETS losses occur before the end of the year at risk.
- Reenlistments can occur anytime during the ETS year, but extensions, by definition, occur only at the end.
- Losses from extension occur any time, although a substantial fraction is concentrated at the end of the extension.

Complications such as these cause what a statistician might call a *sampling bias*. If the airmen who are present at the beginning of a fiscal year are thought of as a sample drawn from the universe of airmen whose year at risk covers the beginning of that fiscal year, that sample will not be truly representative of that universe. It will not include airmen who have already left or who have already reenlisted, but it will contain all the airmen who will eventually extend.

The bias problem is most severe for first-term ETS airmen. To illustrate it, in a 10 percent sample for fiscal year 1984, of the airmen whose first-term ETS year at risk covered the beginning of FY 84, more than half of the reenlistments had already occurred before the fiscal year began. However, most of the losses occurred after the fiscal year began. The loss rate for this year at risk is about 36 percent—the rate

estimated by the cohort loss model. The loss rate for the fiscal year sample is about 42 percent—6 percentage points higher than the cohort loss rate. If these early reenlistees were characteristically different from the later ones, the surviving sample might be sufficiently different from the original universe that it would drive up the estimated loss rates. But these early reenlistees are apparently not much different from the later ones: unadjusted, a loss rate would be assigned to the fiscal year sample that is quite close to what is assigned to the entire universe, thus sharply underestimating the actual fiscal year loss rate.

A second problem involves the question of how to calculate a part-year loss rate using the whole-year loss rates provided by the cohort loss models. There are two situations where this problem has a fairly easy solution. In the first situation, if one can assume all the losses occur at the end of the year at risk, then the part-year loss rate depends on whether the part contains the end of the year at risk: if it contains the end, the part-year loss rate is the same as the year-at-risk rate; if it doesn't contain the end, the loss rate is zero. In the second situation, if one can assume losses are uniformly distributed throughout the year, there is a fairly simple formula (described below) for the part-year loss rate. Unfortunately, few if any models correspond to either of these situations. Although ETS losses are concentrated at year's end, some occur earlier. Attrition losses can happen at any time, but not always uniformly over the year. The distribution over time of losses from extension appears to be quite complicated, perhaps a mixture of losses concentrated at the end with losses that can occur anytime.

Beginning Survival Rates. This section explains how the blending model calculates the beginning survival rate (denoted SURVIVE_BEG in the formula given above). Airmen who will reach retirement eligibility within a year rarely leave before that eligibility is reached. For such airmen, the beginning survival rate is set equal to 1.

Figure 3 shows the relationship between the beginning YAR and a fiscal year. It breaks the beginning YAR into two parts: an *early* part (that occurred before the fiscal year began, denoted "|-----"), and what has already been called the *beginning risk interval* (the part that covers the beginning of the fiscal year, denoted "===>"). We can write:

SURVIVE_YAR = SURVIVE_EAR * SURVIVE_BEG
where
SURVIVE_YAR = Survival rate for the beginning YAR
SURVIVE_EAR = Survival rate for the early part of the YAR
SURVIVE_BEG = Survival rate for the beginning risk interval

From this, it follows that

SURVIVE_BEG = SURVIVE_YAR/SURVIVE_EAR

The beginning cohort loss model provides an estimate of the year-at-risk survival rate, SURVIVE_YAR.[6] All that is needed is an estimate of the early survival rate (SURVIVE_EAR) for each airman.

Early survival rates are estimated by partitioning the airman sample into "early groups," and a survival rate is calculated for each. Early groups are defined as follows: First-term attrition airmen are divided into first-year airmen, last attrition-year airmen, and all the rest. Extenders are divided into decisionmakers and nondecisionmakers. The other early groups coincide with the remaining cohort loss models. Thus there are 15 groups:

First-term attrition, first year
First-term attrition, middle years
First-term attrition, last year
First-term ETS
First-term extension, nondecisionmakers
First-term extension, decisionmakers
Second-term attrition
Second-term ETS
Second-term extension, nondecisionmakers
Second-term extension, decisionmakers
Career-term attrition
Career-term ETS
Career-term extension, nondecisionmakers
Career-term extension, decisionmakers
Retirement

[6]Actually, it provides an estimate of the year-at-risk loss rate. Subtracting this from 1 gives the survival rate.

Each of these groups is stratified by the number of months remaining between the beginning of the fiscal year and the end of the beginning year at risk. This stratifies each group into 12 strata, giving 180 early groups in all. Early survival rates are then calculated from the same YAR file during the merge step of the evaluation run.

Beginning Extend-Given-Stay Rates. This subsection explains how the test and evaluation blending model calculates an extend-given-stay rate that applies to the airmen found at the beginning of the fiscal year. The rate used is denoted XGS in the formula above. Airmen on extension status and ETS airmen are considered.

The cohort loss models do not estimate extend-given-stay rates for airmen on extension status. However, about a quarter of all nondecisionmakers reenlist during the first extension year, making the extend-given-stay rate about 75 percent. Because there was no model to estimate extend-given-stay rates for such airmen, one rate was estimated for each term type (first term, second term, and career term) with a sample of airmen on extension status in FY 84.[7]

For ETS airmen, the extend-given-stay rate provided by the cohort loss model cannot be used without some adjustment. Perhaps an example best explains why. Consider a 10 percent sample of first-term ETS airmen in FY 84, containing 4,563 airmen. Losses, extensions, and reenlistments before and after the fiscal year were as follows:

	Lost	Extend	Reenlist	Stay	Extend-Given-Stay Rate
Before FY began	242	0	894	894	
After FY began	1415	1200	812	2012	60
Entire YAR	1657	1200	1706	2906	41

Because more than half the reenlistments but none of the extensions occurred before the fiscal year began, the group of airmen who entered FY 84 had a much higher extend-given-stay rate than the cohort as a whole. These models do not appear to distinguish between those who reenlist early and those who do not; and when they are applied to the

[7]Specifically, for a 10 percent sample of airmen in FY 84 (SSN4), extend-given-stay rates were 76.0 percent (first term), 76.2 percent (second term) and 73.1 percent (career term).

fiscal-year cohort, they give estimates similar to what they give for the year-at-risk cohort. Hence, in this case, they sharply underestimate the actual extend-given-stay rate.

The following formal analysis shows how to adjust the extend-given-stay rate from the cohort loss model. First of all,

EXTENSIONS = EXTEND_GIVEN_STAY * (NUM_AIRMEN – NUM_LOSSES)

where

EXTENSIONS	=	Number of extensions for the YAR
EXTEND_GIVEN_STAY	=	Extend given-stay-rate for YAR
NUM_AIRMEN	=	Number of airmen
NUM_LOSSES	=	Number of losses

All extensions occur at the end of the year at risk, after the fiscal year begins. The formula that estimates these extensions in terms of the number of "stayers" seen among the fiscal year cohort is

EXTENSIONS = XGS * (NUM_AIRMEN – NUM_LOSSES – NUM_EARLY_REENLIST)

where

XGS	=	Extend given stay rate for FY
NUM_EARLY_REENLIST	=	Number of reenlistments prior to beginning of FY

Equating the right-hand-sides and dividing by the sample size to obtain rates yields

XGS = EXTEND_GIVEN_STAY*SURVIVE_YAR/(SURVIVE_YAR-REENLIST_EAR)

where

REENLIST_EAR = Early reenlistment rate

The cohort loss model is used to estimate SURVIVE_YAR. Values of REENLIST_EAR are calculated for each "early group" from the YAR file that provides the evaluation sample during the merge step of the evaluation run (at the same time as the early survival rates are calculated, as described above).

Notice that the adjustment formula mixes two estimates from the loss models with an actual data element, REENLIST_EAR. Nothing in the formula prevents XGS from exceeding 1—this could happen if the number of early reenlistments is larger than the

models would have predicted for the whole year. In the blending code, XGS is truncated so that it never exceeds 1.

Ending Survival Rates. This section explains how the blending model calculates the ending survival rates, denoted SURVIVE_REN and SURVIVE_EXT in the blending formula.

If the airman ends up in an ETS year at risk, the ETS decision will not take place until the *next* fiscal year, so only attrition losses can occur during the current fiscal year. The loss rate provided by the beginning attrition model is used to estimate this subsequent attrition loss rate. Thus, SURVIVE_REN is always based on an attrition model.

The distribution of attrition losses over the year at risk appears to be complicated, but to calculate ending risk interval survival rates the simplification has been adopted that they are uniformly distributed over time. This hypothesis leads to a simple formula for the survival rate over any part of a year as follows.

Suppose the survival rate for a year at risk is denoted SURVIVE_YAR, and the daily survival rate is denoted SURVIVE_ONE_DAY. By the assumption of uniformity, the survival rate is the same every day of the year, and

$$\text{SURVIVE\_YAR} = \text{SURVIVE\_ONE\_DAY}^{365}$$

Then the probability of surviving N days, denoted SURVIVE_DAY(N), is

$$\begin{aligned}\text{SURVIVE\_DAY(N)} &= \text{SURVIVE\_ONE\_DAY}^{N} \\ &= \text{SURVIVE\_YAR}^{(N/365)}\end{aligned}$$

The probability of surviving some fraction F of a year,

(0 <= F <= 1), denoted SURVIVE_FRA(F), is

$$\text{SURVIVE\_FRA(F)} = \text{SURVIVE\_YAR}^{F}$$

This formula is used for both extending and reenlisting survival rates.

If the extending model is an extension model, the extending model loss rate is used, just as an attrition model does. This assumption is certainly appropriate for nondecisionmakers, where losses would be similar to attrition losses. The assumption may seem inappropriate for decisionmakers, who should be similar to airmen in their ETS years. However, the distribution of losses over the year at risk for extension decisionmakers is quite different from that for ETS airmen; the losses are *not* concentrated at the end of the year, but are much more spread out. For one-year extensions, the loss rates seem quite uniformly distributed over the year, except for concentrations at 3, 6, 9, and 12 months. For two-year extensions, losses concentrate substantially at the very end of the two-year term, but earlier losses are much higher than observed in attrition models, so the "trick" used for the ETS model does not seem appropriate. Assuming uniform distribution seems the best compromise, given what is known at this time. This problem deserves more research.

Step 5: Compare. The process described above yields a file containing a record for each airman found at the beginning of the fiscal year. The file contains an airmen identifier and any other characteristics desired (grade, AFSC, etc.). With such a file, the number of losses over the fiscal year may be calculated for any group of airmen by simply adding up the loss probabilities over all airmen in that group.

To compare the estimates with what actually happened, the YAR file is read again, this time with years at risk that cover the beginning of the next fiscal year. All the airmen are sought who were in the original sample. Airmen whose records cannot be found are assumed lost. Airmen whose records indicate that they left before the new fiscal year began but who were not early-outs are also assumed lost. This process yields another file containing one record for every airmen in the original sample and a dummy variable set equal to 0 if the airman is not in the service at the beginning of the new fiscal year, and 1 if he is.

When these two files are combined, it is possible to calculate the actual size of any definable group. A comparison of actual with predicted sizes permits an evaluation of the model performance.

MODEL PERFORMANCE

This section discusses the performance of the blended loss models. The models were calibrated with data through FY 83. Data are available only through FY 85, and the blended models require two fiscal years of data. Therefore, only FY 84 is discussed. It is the only year for which a true evaluation of the blended loss models can be made; any earlier year would require using data that were also used for calibration, and data for later years were not available at the time of the analysis.

The discussion is in two parts. First the overall performance of the models is shown. Then the performance of the three worst-performing models is discussed in order to discover the sources of the errors so that they can be improved.

Performance Overview

Table 3.1 summarizes the performance of the blended models, stratifying the sample by the beginning model and "early group" defined earlier.

Out of a sample of nearly 48,000 airmen, the models combine to overpredict losses by about 200 airmen, with a relative error of just over 4 percent. Although this is

Table 3.1

BLENDED PERFORMANCE BY BEGINNING MODEL AND GROUP

Beginning Model/Group	Airmen at Risk	Loss Rate (%) Predicted	Loss Rate (%) Actual	PE	PRE (%)	PEPNR (%)	SPE
All	47775	11.4	10.9	217	0.5	4.2	3.1
1ATT 1st yr	5798	9.1	6.0	184	3.2	53.3	8.4
1ATT Middle	6999	9.3	8.4	64	0.9	10.9	2.6
1ATT Last yr	5187	6.3	8.1	−94	−1.8	−22.3	−5.4
1ETS	3488	51.1	46.9	147	4.2	9.0	5.0
1EXT Att	479	20.5	18.6	9	1.9	10.1	1.0
1EXT DOS	776	41.1	41.6	−4	−0.5	−1.2	−0.3
2ATT	8794	2.2	4.3	−181	−2.1	−47.9	−13.0
2ETS	1041	23.3	17.1	65	6.2	36.5	4.8
2EXT Att	337	9.2	5.0	14	4.2	82.4	2.6
2EXT DOS	201	25.9	16.9	18	9.0	52.9	2.9
CATT	9605	1.7	1.6	5	0.1	3.2	0.4
CETS	1531	2.8	2.9	−2	−0.1	−4.4	−0.3
CEXT Att	283	3.5	2.5	3	1.1	42.9	1.0
CEXT DOS	168	8.9	5.4	6	3.6	66.7	1.6
RET	3088	31.3	31.9	−17	−0.6	−1.7	−0.7

low, the standardized error of about 3.0 is too high to support the hypothesis that the overprediction is due to chance alone.

In seven of the 16 model/groups, the absolute value of the standardized prediction error is less than 2.0, suggesting that for these groups the discrepancy between actual and predicted losses is due to chance. In particular, the career model/groups and the retirement model predictions are all quite accurate; these groups combined account for nearly a third of the sample. However, career model loss rates are very low. Of the models with moderate to high loss rates, the retirement model does the best job, with a standardized prediction error well within the range that could be expected to occur by chance alone.

Large errors can be seen in the first- and second-term attrition model groups, and in first-term ETS. The next section will show that these errors seem to be due to problems in the component cohort loss models, although the possibility that they are also due to errors in the blending model cannot be ruled out.

Detailed Analysis

The blended loss rates result from a combination of the cohort loss models and the blending model. The fiscal year evaluation is as much a test of the first effort as it is of the second. But there is an asymmetry in the two groups of models: The cohort loss models can be tested without the blending models, but the blending models cannot be tested without the cohort loss models. This asymmetry constrains the ability to test the blending model: Only when the cohort loss model is eliminated as a source of error can the blending model be tested.

The sharp differences between predicted and actual loss rates for the first- and second-term attrition models and for first-term ETS were rated above. These differences challenge the accuracy of either the blending model or of the component cohort loss models (or both). But before it is possible to analyze the blending model as a source of the problem, errors should be eliminated from the cohort loss models. In what follows, it will be shown that the discrepancies are largely due to the cohort loss models; therefore, such errors in the blending model as remain cannot be revealed by merely examining performance.

For first-term attrition, it is necessary merely to discuss airmen in their first and last year, as the story for the middle year is much the same.

First-Year, First-Term Attrition

Table 3.2 presents an accounting of predicted and actual losses for a sample of airmen whose first year of their first term covered the beginning of FY 84. The beginning of this year coincided with the beginning of the fiscal year for only a small fraction of airmen, so of the 6,220 airmen in the sample, some 422 had left the service before the fiscal year began, leaving 5,798 at the beginning of the fiscal year. It is these 5,798 airmen to whom the blended loss model applies.

The loss rates displayed in Table 3.2 are not annual loss rates; they are simply the ratios of the losses to the number at risk expressed as a percent. The time at risk for each group is, on the aveiage, six months. Notice that the actual loss rate before the beginning of the fiscal year (6.8 percent) is much higher than the actual loss rate afterward (3.0 percent) because the tendency to drop out in the first half of the first year of service is greater than in the second half.

The loss rate for the entire first year at risk is (422 + 175) divided by 6,220, or 9.6 percent. That is the number that the cohort loss model attempts to predict. Table 2.5 for FY 84 showed that the predicted cohort loss rate for airmen in their first year of service is 11.0 percent.[8] Therefore, the predicted cohort loss rates are too high. Such a rate applied to the 6,220 airmen in the year at risk would yield a predicted 684 losses. Subtracting the 422 actual early losses leaves 262 predicted losses for the first part of the fiscal year, for a predicted loss rate in the first part of the fiscal year of 4.5 percent, quite close to the rate of 4.8 percent seen in Table 3.2. The discrepancy between actual and predicted loss rates

Table 3.2

PREDICTED AND ACTUAL LOSSES, FIRST-YEAR, FIRST-TERM ATTRITION
(Loss rates in parentheses)

	Actual		Predicted	
Beginning of YAR:	6,220			
Early losses	422	(6.8)		
Beginning of FY:	5,798		5,798	
Remaining YAR losses	175	(3.0)	281	(4.8)
Beginning of next YAR:	5,623		5,517	
Early losses	170	(3.0)	248	(4.5)

[8]Table 2.5 showed an actual loss rate of 9.4 percent, which is not substantially different from the rate of 9.6 percent seen in Table 3.2.

in the first half of FY 84 appears to be due largely to an overprediction in the cohort loss model.

Losses in the second half of FY 84 should be compared with the performance of the cohort loss model for airmen in their second year of service for FY 85. Table 2.5 showed that the actual loss rate for such airmen, 7.1 percent, is somewhat lower than the predicted loss rate of 9.0 percent. Compared with Table 3.2, these rates have to be adjusted to the time at risk of six months. Assuming that losses are uniform over the second year, adjusting the loss rates in Table 2.5 to six months gives a predicted loss rate of 4.6 percent and an actual loss rate of 3.6 percent. This explains most of the difference between loss rates seen in the bottom line of Table 3.2, although it suggests that the assumption built into the blending code that losses are uniform over time may not be quite correct.

Blended predicted losses for first-year airmen are sharply higher than the loss rates actually observed. This overprediction appears to be caused by the cohort loss models' overpredicting losses for first- and second-year airmen.

Last-Year, First-Term Attrition

Table 3.3 presents an accounting of predicted and actual losses for a sample of airmen whose last first-term attrition year covered the beginning of FY 84. Table 3.3 will not be analyzed as closely as Table 3.2. Table 3.1 noted that the predicted loss rate for FY 84 was somewhat lower than the actual loss rate for these airmen. Here the major source of this difference appears to be due to the losses seen in the first part of FY 84,

Table 3.3

PREDICTED AND ACTUAL LOSSES, LAST-YEAR, FIRST-TERM ATTRITION
(Loss rates in parentheses)

	Actual		Predicted	
Beginning of YAR:	5,420			
Early losses	230	(4.2)		
Early reenlistments	3			
Beginning of FY:	5,187		5,187	
Remaining YAR losses	267	(5.1)	177	(3.4)
Reenlistments	74		0	
Beginning of next YAR:	4,463		5,010	
Early losses	159	(3.6)	150	(3.0)

where the actual loss rate is 5.1 percent; the predicted loss rate is just 3.4 percent. Most of these airmen are in their third year of service, and from Table 2.5 for such airmen, the annual loss rate predicted by the cohort loss model, 7.1 percent, falls somewhat below the actual loss rate of 9.4 percent. Thus, the difference seen here is accounted for by the cohort loss model.

First-Term ETS

Table 3.1 showed a predicted fiscal year loss rate of 51.1 percent, sharply higher than the actual rate of 46.9 percent, for first-term ETS airmen. The model predicts 146 too many losses. Table 3.4 presents an accounting of the sample used to calculate these tables. It is a complicated table, but the predicted number of losses in the beginning of the fiscal year exceeds the actual number by 146 airmen.

Table 2.3 showed that the predicted cohort loss rates for first-term ETS airmen in FY 84 is 38.9 percent, while the actual rate is 36.5 percent. These rates apply to a year at risk, not to a fiscal year, cohort. Applying this rate to the 4,563 airmen in the entire year at risk yields an estimated 1,775 losses, and if the 242 early losses are subtracted, 1,533

Table 3.4

PREDICTED AND ACTUAL LOSSES, FIRST-TERM ETS
(Loss and extend-given-stay rates are in parentheses)

	Actual		Predicted		Predicted–Actual
Beginning of YAR:	4,563				
Early outs	61				
Other early losses	181				
Early losses	242	(5.3)			
Early reenlistments	894				
Beginning of FY:	3,427		3,427		146
Remaining YAR losses	1,415	(41.3)	1,561	(45.6)	
"Stayers"	2,012		1,866		
Extensions	1,200	(59.6)	1,275	(68.3)	75
Short extensions	606		595		
Losses	150	(24.8)	140	(23.5)	−10
Long extensions	594		680		
Losses	12	(2.0)	17	(2.5)	5
Reenlistments	812		591		
Losses	9	(1.1)	2	(0.3)	−7

losses are predicted to occur after the fiscal year began. The number of losses predicted by the blended model exceeded this number by 28 airmen. This part of the error may be charged to the blending model, although sampling error may be some small part of it. The year at risk sample has been reduced through losses and reenlistments by 25 percent by the time the fiscal year begins. The blending model attempts to adjust the loss predictions for these early losses but may not go far enough.

To summarize, the blended model overestimates losses before the end of the year at risk by 146. Of the 146 overestimated, 118 may be due to the cohort loss model and 28 may be due to the blending model. In percentage terms, about 81 percent of the overprediction may be due to the cohort loss model.

There is a sharp difference between the actual and predicted extend-given-stay rates for the airmen who survived to the beginning of the fiscal year. This difference appears to be due, at least in part, to a similar difference in the predicted and actual cohort extend-given-stay rates, as reported in Table 2.4. Had the two extend-given-stay rates been closer, the net discrepancy would have been reduced by about 20 airmen. Although improving the cohort extend-given-stay model is a goal worth pursuing, improving the loss model is much more important.[9]

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[9]Subsequent to the test and evaluation of this model, a new and greatly improved first-term ETS loss model was estimated.

IV. COMPARISON WITH ALPS

INTRODUCTION

The ALPS Model

The Airman Loss Probability System (ALPS) provides projected loss rate estimates to the Airmen Skill Force Model (ASKIF), which is the principal tool currently being used by the Air Force to estimate the annual requirements for trained enlisted personnel by Air Force specialty (AFSC). ALPS will be maintained until it is replaced by the EFMS middle-term disaggregate loss models discussed here.

ALPS calculates loss rates using data from the preceding 12 months. It partitions the previous year's inventory into several classes, calculates the loss rate within each class, and then assumes that the same loss rates will be observed within each class for the current inventory.

In any of these classes, the ALPS prediction error can be expressed in the form:

$$\text{ERROR} = (P(y) - P(y-1)) * N(y)$$

where

N(y)	=	number of airmen in the class
P(y)	=	this year's loss rate for the class
P(y-1)	=	last year's loss rate for the class

The ALPS model can be sensitive to *distributional* changes in the force (changes in the number of airmen in AFSCs, grade levels, etc). If from one year to the next a large movement of airmen were to occur from a low-loss rate class to a high-loss rate class, ALPS could accurately track the effects of that change. ALPS is insensitive to changes in the underlying loss rate that might be caused by changes in external circumstances, however, such as the unemployment rate, the military/civilian pay ratio, etc. If from one year to the next the unemployment rate were to fall sharply and civilian pay were to rise sharply compared with military pay in some occupational class, ALPS would not be able to predict the increase in losses that might occur because of these shifts in the economy.

Comparison Years

EFMS was compared with ALPS for FY 82 and FY 84. FY 84 is the only fiscal year for which data are currently available that were not used for the estimation. However, FY 84 is a somewhat unfortunate year for making a comparison. ALPS uses the previous fiscal year to calculate loss rates. When there is little change in the economy or in Air Force compensation policies from one year to the next, both ALPS and EFMS should do reasonably well and produce similar loss predictions. In those aspects of change to which the EFMS model is sensitive (unemployment and wages), FY 83 and FY 84 were quite similar, as the following shows:

	FY 83	FY 84
Unemployment rate (ages 20–24)	14.8	14.2
Military/Civilian wage ratio	0.943	0.940

On the basis of this similarity, the performance of ALPS and the EFMS models should be quite similar, and it was.

A quick scan of other years suggested that FY 82 might show a different picture. Economic changes were indeed greater, as the following shows:

	FY 81	FY 82
Unemployment rate	11.5	12.2
Military/Civilian wage ratio	0.953	0.993

EFMS was compared with ALPS for FY 82 also, although data from FY 82 were used to estimate the EFMS models. However, FY 82 was not the *only* year used to estimate the EFMS models, but was only one of seven such years.

Data Processing

Tapes containing FY 82 and FY 84 ALPS estimates were obtained from the Air Force. Airman records on the ALPS tapes are identified by the airman's Social Security Number (SSN), but for privacy reasons this number is not kept on the YAR files used for estimation and evaluation. The ALPS files were merged with a cross-walk file, and files were created containing the ALPS estimates in which the airmen were identified by the YAR variable that identifies each airman (a variable called BID). Two 10 percent samples were set aside, one for FY 82 (corresponding to the YAR sample in which the airman's SSN ends in a 3) and one for FY 84 (corresponding to the YAR sample in which the airman's SSN ends in a 4).

The ALPS records contain several loss rates. The one called *Total Loss Probability*, which is the probability of any kind of loss, attrition, ETS, etc., over the fiscal year was the one used.

The end of a series of somewhat complicated steps in Sec. III yielded a file containing one record for each airman found at the beginning of a fiscal year, along with his EFMS loss probability, an indicator as to whether he was actually in the force at the beginning of the next fiscal year, and any other desired characteristics, including his YAR identifier, BID. It is a technically simple matter, therefore, once the steps described in Sec. III are complete, to merge this file with the corresponding ALPS samples just described, and obtain a file with the ALPS estimate of the airman's loss probability alongside that of the EFMS estimate.

Such files were created for FY 84 and FY 82 and then merged with the corresponding ALPS samples. The match was extremely good. Of approximately 50,000 cases in both samples, only a handful of records could not be matched, either because they were found in the YAR file but were not in the ALPS file, or vice versa.

RESULTS OF THE COMPARISON

Tables 4.1 and 4.2 show the results of the comparisons for FY 84 and FY 82 respectively, presented by loss model category, except that the first term attrition model is partitioned into three subgroups: (1) first-year airmen; (2) "last-year airmen"—by which is meant the last attrition year, which could be the third year of a four-year term or the fifth year of a six-year term; and (3) "middle airmen"—neither first year nor last. The categories in these tables are the same as those of Table 3.1.

Table 4.1

EFMS-ALPS COMPARISON, FY 84

Beginning Submodel Group	Airmen at Risk	Loss Rates (%)			PE (%)		PEPNR (%)	
		Actual	EFMS	ALPS	EFMS	ALPS	EFMS	ALPS
All	47735	10.9	11.3	9.4	221	−703	0.5	−1.5
1ATT 1st yr	5792	5.9	9.1	7.2	184	74	3.2	1.3
1ATT Middle	6999	8.4	9.3	6.3	64	−149	0.9	−2.1
1ATT Last yr	5183	8.1	6.3	6.6	−94	−80	−1.8	−1.5
1ETS	3487	46.9	51.1	42.0	147	−170	4.2	−4.9
1EXT Att	479	18.6	20.5	19.4	9	4	1.9	0.8
1EXT DOS	768	42.1	40.9	44.8	−9	21	−1.2	2.7
2ATT	8785	4.3	2.2	3.0	−177	−108	−2.0	−1.2
2ETS	1040	17.1	23.4	13.4	65	−39	6.3	−3.8
2EXT Att	337	5.0	9.2	4.2	14	−3	4.2	−0.9
2EXT DOS	200	16.5	26.0	17.0	19	1	9.5	0.5
CATT	9599	1.6	1.7	1.1	7	−42	0.1	−0.4
CETS	1529	2.9	2.8	3.0	−1	2	−0.1	0.1
CEXT Att	283	2.5	3.5	1.4	3	−3	1.1	−1.1
CEXT DOS	167	4.8	9.0	4.2	7	−1	4.2	−0.6
RET	3087	31.8	31.3	25.0	−17	−210	−0.6	−6.8

The number of airmen at risk in Table 4.1 is slightly lower than the corresponding number in Table 3.1 because of a small number (40 in all) of airmen whose ALPS records could not be matched to the YAR file. This number is very small compared with the total (less than 0.1 percent) and the unmatched cases are spread seemingly at random over all the models; it was therefore not worth the effort to resolve the difference, or even find out why they differed. In addition, a handful of ALPS records could not be matched to the YAR file, and those have been ignored also.

Table 4.1 shows that the EFMS model comes closer overall to estimating the total number of FY 84 losses than does ALPS. EFMS overestimates the total number of losses by 221 airmen, while ALPS underestimates it by 703 airmen. Both errors are larger in absolute value than one would expect to see by chance alone: The standard deviation of an unbiased estimator of the number of losses is about 68 airmen.

Looking at specific submodels or model groups in Table 4.1, there are several exceptions to the average result that EFMS overpredicts losses while ALPS underpredicts them. Perhaps the most notable occurs in the second-term attrition model, where both models underpredict the losses, with EFMS predicting even fewer than

Table 4.2

EFMS-ALPS COMPARISON, FY 82

Beginning Submodel Group	Airmen at Risk	Loss Rates (%)			PE (%)		PEPNR (%)	
		Actual	EFMS	ALPS	EFMS	ALPS	EFMS	ALPS
All	43418	9.4	12.7	13.7	1454	1884	3.3	4.3
1ATT 1st yr	6595	6.2	9.6	7.5	222	84	3.4	1.3
1ATT Middle	5984	7.2	9.1	7.1	115	−7	1.9	−0.1
1ATT Last yr	4441	5.1	8.6	18.2	155	581	3.5	13.1
1ETS	3833	36.2	43.0	50.9	263	564	6.9	14.7
1EXT Att	696	13.8	22.8	29.2	63	107	9.1	15.4
1EXT DOS	775	31.7	46.2	54.7	112	178	14.5	23.0
2ATT	5548	1.9	2.5	3.3	34	80	0.6	1.4
2ETS	1044	17.1	23.4	21.2	65	42	6.2	4.0
2EXT Att	488	5.5	9.6	9.6	20	20	4.1	4.1
2EXT DOS	324	13.6	26.9	20.1	43	21	13.3	6.5
CATT	8442	0.8	2.2	1.7	122	80	1.4	0.9
CETS	1665	3.4	3.8	5.9	8	42	0.5	2.5
CEXT Att	430	1.2	3.7	3.7	11	11	2.6	2.6
CEXT DOS	213	5.2	9.4	6.6	9	3	4.2	1.4
RET	2940	26.7	33.9	29.3	212	78	7.2	2.7

ALPS. A similar event can be seen for the last year of the first-term attrition model. But in 11 out of 15 cases in Table 4.1, ALPS predicts fewer losses than EFMS. In seven out of the 15 cases, the ALPS prediction is closer to what actually happened than the EFMS prediction. Generally speaking, the two models perform about equally well, though neither performs extremely well.

Table 4.2 presents the same comparison for FY 82. Recall that this was a year chosen because conditions were changing more rapidly from one year to the next: The unemployment rate was rising, the military/civilian pay ratio was rising, and loss rates had decreased sharply between FY 81 and FY 82. Both EFMS and ALPS sharply overpredict losses, but overall EFMS predicts fewer losses than ALPS. For the first-term ETS model, the ALPS overprediction is twice that of EFMS, possibly because the first-term ETS model has explicit economic-sensitive terms that reduce loss-rate predictions in response to rising unemployment and military civilian wage ratios. However, EFMS predicts more losses than ALPS for the second-term ETS model, which also contains such terms.

Table 4.2 suggests that while EFMS may be a little more sensitive to annual changes than ALPS, neither is sensitive enough.

Following is a model-by-model comparison of EFMS with ALPS, and of both with the actual results, for FY 82 and FY 84. There are 10 sets of results, one for each of the 10 major classes of middle-term disaggregate loss models. Within each set are presented tables containing detailed comparisons by several stratification categories: bonus level, Career Field Group,[1] grade, term of enlistment, term year, and year of service.

The tables are meant to serve as benchmarks for future evaluation efforts. So the discussions, if any, will be brief and meant to diagnose possible problems that remain either with the EFMS models or with the evaluation effort itself.

First-Term Attrition

Tables 4.3 and 4.4 compare EFMS and ALPS for the first-term attrition model for FY 82 and FY 84 respectively.

Table 4.3 reveals something strange with respect to the bonus level: Losses were practically nonexistent among airmen receiving a one-half bonus. ALPS reflects this phenomenon slightly with a little dip in the estimated loss rate; but EFMS fails and instead predicts *higher* losses. Nothing like that happened in FY 84, so the event probably reflects the implementation of some policy that was in place in FY 82 but not in FY 84.

The previous section pointed out that EFMS tended to overpredict FY 84 losses while ALPS tended to underpredict. This pattern can be observed in Table 4.4. Little in that table explains why.

First-Term ETS

Tables 4.5 and 4.6 compare EFMS and ALPS for the first-term ETS model for FY 82 and FY 84 respectively. Both EFMS and ALPS exhibit sizable prediction errors, especially for FY 82. The EFMS first-term ETS model has been respecified to reduce the size of its prediction error.

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[1]See Table A.1 of Carter et al. (1987) for definitions.

Table 4.3

FIRST-TERM ATTRITION, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	8703	4.5	9.5	10.4	439	511	5.0	5.9
	0.5	2032	.4	10.0	7.0	195	134	9.6	6.6
	1.0	2892	6.7	8.0	12.6	36	170	1.2	5.9
	2.0	918	2.1	6.8	10.0	43	73	4.7	8.0
	3.0	592	6.3	7.1	11.0	5	28	.8	4.7
Occupational Group	CrfSer	1709	7.4	13.2	13.8	98	109	5.7	6.4
	ElMeRe	2792	6.4	8.3	12.3	53	164	1.9	5.9
	SkilTe	3186	5.8	7.2	11.6	45	185	1.4	5.8
	Suppor	1953	5.1	8.3	11.6	64	128	3.3	6.6
Grade	1	2852	9.0	9.9	7.7	23	−37	.8	−1.3
	2	4806	7.7	8.6	7.4	45	−13	.9	−.3
	3	5931	5.7	9.1	14.5	204	521	3.4	8.8
	4	675	3.1	8.0	12.3	33	62	4.9	9.2
Term of Enlistment	4	15444	6.3	9.1	10.3	421	612	2.7	4.0
	6	1541	5.5	10.1	8.5	72	47	4.7	3.0
Term Year	1	6595	6.2	9.6	7.5	222	84	3.4	1.3
	2	5697	7.3	9.1	7.1	101	−13	1.8	−.2
	3	4507	5.2	8.8	17.6	162	559	3.6	12.4
	5	133	4.5	5.3	21.1	1	22	.8	16.5
Year of Service	0	6626	6.3	9.6	7.5	215	77	3.2	1.2
	1	5677	7.3	9.1	7.1	103	−11	1.8	−.2
	2	4495	5.1	8.8	17.6	166	564	3.7	12.5
	4	133	4.5	5.3	21.1	1	22	.8	16.5

Table 4.4

FIRST-TERM ATTRITION, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	6211	7.9	8.5	6.6	38	−81	.6	−1.3
	0.5	2219	8.6	10.2	6.4	35	−48	1.6	−2.2
	1.0	2069	8.8	6.9	6.3	−40	−52	−1.9	−2.5
	2.0	988	7.4	5.2	6.0	−22	−14	−2.2	−1.4
	3.0	551	5.8	4.5	6.0	−7	1	−1.3	.2
Occupational Group	CrfSer	1922	9.4	13.1	6.6	71	−55	3.7	−2.9
	ElMcRc	3346	8.6	8.1	6.6	−15	−67	−.4	−2.0
	SkilTc	3645	7.3	6.2	6.1	−39	−41	−1.1	−1.1
	Suppor	1508	8.3	8.6	6.6	4	−26	.3	−1.7
Grade	1	4099	6.7	9.4	7.3	114	26	2.8	.6
	2	5417	7.4	8.9	6.5	81	−45	1.5	−.8
	3	7356	7.6	7.5	6.4	−8	−90	−.1	−1.2
	4	869	6.9	7.7	6.4	7	−4	.8	−.5
Term of Enlistment	4	15436	7.3	8.0	6.7	115	−94	.7	−.6
	6	2510	9.0	10.6	6.6	41	−60	1.6	−2.4
Year of Service	0	5802	6.0	9.1	7.2	183	71	3.2	1.2
	1	6002	8.1	9.2	6.3	71	−108	1.2	−1.8
	2	5543	8.4	6.7	6.5	−95	−103	−1.7	−1.9
	3	464	9.7	9.3	6.9	−2	−13	−.4	−2.8
	4	162	8.0	6.8	6.2	−2	−3	−1.2	−1.9

Table 4.5

FIRST-TERM ETS, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	1.0	1420	36.3	43.2	52.5	98	231	6.9	16.3
	2.0	218	44.0	42.7	55.0	-3	24	−1.4	11.0
	3.0	167	37.7	45.5	52.1	13	24	7.8	14.4
Occupational Group	CrfScr	671	38.2	47.2	50.4	61	82	9.1	12.2
	ElMcRe	1193	37.6	42.9	53.1	63	184	5.3	15.4
	SkilTc	1262	38.3	45.5	52.6	91	181	7.2	14.3
	Suppor	687	27.5	34.2	44.5	46	117	6.7	17.0
Grade	3	137	47.4	46.7	56.2	−1	12	−.7	8.8
	4	3517	35.6	43.1	50.9	263	536	7.5	15.2
	5	126	26.2	35.7	42.9	12	21	9.5	16.7

Table 4.6

FIRST-TERM ETS, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	2165	45.0	48.3	40.6	70	−97	3.2	−4.5
	0.5	516	49.2	59.7	44.2	54	−26	10.5	−5.0
	1.0	472	46.4	51.5	43.9	24	−12	5.1	−2.5
	2.0	231	57.1	55.4	46.3	−4	−25	−1.7	−11
Occupational Group	CrfScr	532	45.9	55.3	44.7	50	−6	9.4	−1.1
	ElMcRe	954	50.7	54.9	43.9	40	−65	4.2	−6.8
	SkilTc	1156	50.3	54.2	43.5	44	−79	3.8	−6.8
	Suppor	815	38.4	39.4	36.2	8	−18	1.0	−2.2
Grade	3	1694	46.2	49.8	40.7	61	−94	3.6	−5.5
	4	1711	46.7	52.1	43.2	93	−60	5.4	−3.5

First-Term Extension

Tables 4.7 and 4.8 compare EFMS and ALPS for the first-term extension model for FY 82 and FY 84 respectively.

Table 4.7

FIRST-TERM EXTENSION, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	1108	23.6	34.7	44.4	123	231	11.1	20.8
	1.0	283	20.5	34.3	36.7	39	46	13.8	16.3
Occupational Group	CrfSer	223	22.4	33.6	41.7	25	43	11.2	19.3
	ElMeRe	452	22.6	33.2	40.9	48	83	10.6	18.4
	SkilTe	449	27.8	40.3	45.7	56	80	12.5	17.8
	Suppor	326	19.6	30.4	43.9	35	79	10.7	24.2
Grade	4	1184	22.6	34.4	42.7	139	237	11.7	20.0
	5	246	26.0	37.0	45.1	27	47	11.0	19.1
Term of Enlistment	4	1329	23.7	34.6	43.2	145	259	10.9	19.5
	6	117	22.2	37.6	42.7	18	24	15.4	20.5
Term Year	5	1067	21.0	33.6	39.9	135	202	12.7	18.9
	6	242	36.0	39.7	59.1	9	56	3.7	23.1
	7	101	14.9	35.6	35.6	21	21	20.8	20.8
Year of Service	4	1056	21.1	33.6	40.1	132	200	12.5	18.9
	5	243	35.8	39.5	59.3	9	57	3.7	23.5
	6	102	15.7	36.3	35.3	21	20	20.6	19.6

Table 4.8

FIRST-TERM EXTENSION, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%)			PE (%)		PEPNR (%)	
			Actual	EFMS	ALPS	EFMS	ALPS	EFMS	ALPS
Bonus	0.0	859	30.0	31.9	34.0	16	34	1.9	4.0
	1.0	264	37.1	35.2	39.0	−5	5	−1.9	1.9
Occupational Group	CrfSer	251	29.1	31.1	34.7	5	14	2.0	5.6
	ElMeRe	260	37.3	31.5	36.9	−15	−1	−5.8	−.4
	SkilTe	357	40.3	40.9	38.4	2	−7	.6	−2.0
	Suppor	364	25.8	26.9	30.8	4	18	1.1	4.9
Grade	4	950	33.2	32.7	34.3	−4	11	−.4	1.2
	5	255	30.2	34.1	37.3	10	18	3.9	7.1
Term Year	5	812	29.1	31.5	30.0	20	8	2.5	1.0
	6	369	41.5	35.8	47.2	−21	21	−5.7	5.7
Year of Service	4	814	28.9	31.3	30.1	20	10	2.5	1.2
	5	365	41.6	36.2	47.4	−20	21	−5.5	5.8

Second-Term Attrition

Tables 4.9 and 4.10 compare EFMS and ALPS for the second-term attrition model for FY 82 and FY 84 respectively.

Second-Term ETS

Tables 4.11 and 4.12 compare EFMS and ALPS for the second-term ETS model for FY 82 and FY 84 respectively.

Second-Term Extension

Tables 4.13 and 4.14 compare EFMS and ALPS for the second-term extension model for FY 82 and FY 84 respectively.

Career Attrition

Tables 4.15 and 4.16 compare the career attrition loss rates from the EFMS and ALPS models for FY 82 and FY 84 respectively. In both years, an anomaly can be seen for airmen in their 17th and 18th years of service. Although the actual loss rates are quite low for such airmen, both EFMS and ALPS predict higher losses. The higher

Table 4.9

SECOND-TERM ATTRITION, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%)			PE (%)		PEPNR (%)	
			Actual	EFMS	ALPS	EFMS	ALPS	EFMS	ALPS
Bonus	0.0	3724	1.7	2.7	3.2	35	55	.9	1.5
	1.0	1434	2.4	2.2	3.5	–4	15	–.3	1.0
	2.0	190	2.1	2.1	3.7	0	3	0.0	1.6
Occupational Group	CrfSer	689	2.6	2.8	3.0	1	3	.1	.4
	ElMcRc	1648	1.6	2.1	3.3	8	27	.5	1.6
	SkilTc	1823	1.6	2.4	3.6	13	35	.7	1.9
	Suppor	1288	2.1	3.1	3.2	13	14	1.0	1.1
Grade	3	245	2.4	1.2	3.7	–3	3	–1.2	1.2
	4	2987	2.2	3.2	3.2	30	30	1.0	1.0
	5	2219	1.3	1.7	3.4	10	47	.5	2.1
Term of Enlistment	4	3917	2.0	2.6	3.4	22	55	.6	1.4
	5	140	.7	1.4	2.9	1	3	.7	2.1
	6	1491	1.7	2.5	3.2	11	21	.7	1.4
Term Year	1	2015	1.5	1.9	2.9	8	28	.4	1.4
	2	1823	1.9	2.9	2.7	18	14	1.0	.8
	3	1378	2.8	2.9	4.6	1	24	.1	1.7
	4	179	0.0	2.2	2.8	4	5	2.2	2.8
	5	153	.7	2.6	5.9	3	8	2.0	5.2
Year of Service	3	769	1.7	2.2	2.7	4	8	.5	1.0
	4	1325	2.2	2.6	2.9	6	10	.5	.8
	5	1406	2.5	2.8	3.3	5	12	.4	.9
	6	998	1.2	2.5	3.2	13	20	1.3	2.0
	7	648	1.5	2.3	4.3	5	18	.8	2.8
	8	187	1.6	2.1	3.7	1	4	.5	2.1

Table 4.10

SECOND-TERM ATTRITION, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	5534	4.4	2.3	3.1	−111	−68	−2.0	−1.2
	0.5	285	6.0	2.1	3.2	−11	−8	−3.9	−2.8
	1.0	2404	3.8	2.1	2.8	−42	−24	−1.7	−1.0
	2.0	247	3.6	2.0	2.8	−4	−2	−1.6	−.8
	3.0	227	4.0	1.8	2.6	−5	−3	−2.2	−1.3
Occupational Group	CrfSer	1116	4.4	2.5	3.3	−21	−12	−1.9	−1.1
	ElMeRe	3018	4.6	2.0	2.9	−79	−51	−2.6	−1.7
	SkilTe	2863	3.6	2.1	2.9	−44	−21	−1.5	−.7
	Suppor	1678	4.4	2.7	3.2	−29	−20	−1.7	−1.2
Grade	3	279	8.6	1.1	3.9	−21	−13	−7.5	−4.7
	4	4920	5.0	2.9	3.2	−103	−89	−2.1	−1.8
	5	3454	2.2	1.5	2.7	−24	19	−.7	.6
Term of Enlistment	4	5132	4.7	2.3	3.2	−126	−80	−2.5	−1.6
	5	251	3.2	.8	2.8	−6	−1	−2.4	−.4
	6	3399	3.6	2.3	2.9	−45	−27	−1.3	−.8
Term Year	1	3459	4.1	1.8	3.4	−80	−26	−2.3	−.8
	2	2822	4.6	2.5	2.8	−60	−52	−2.1	−1.8
	3	1941	4.4	2.6	2.8	−34	−31	−1.8	−1.6
	4	366	2.5	2.2	3.0	−1	2	−.3	.5
	5	197	3.6	2.5	3.0	−2	−1	−1.0	−.5
Year of of Service	3	1662	4.3	2.0	3.5	−39	−14	−2.3	−.8
	4	2103	4.8	2.4	3.1	−51	−36	−2.4	−1.7
	5	2282	4.4	2.5	2.9	−44	−34	−1.9	−1.5
	6	1337	3.5	2.3	2.8	−16	−10	−1.2	−.7
	7	692	3.8	2.0	2.7	−12	−7	−1.7	−1.0
	8	393	3.1	1.8	2.8	−5	−1	−1.3	−.3
	9	179	3.9	2.2	2.8	−3	−2	−1.7	−1.1

Table 4.11

SECOND-TERM ETS, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	601	14.5	24.0	19.6	57	31	9.5	5.2
	1.0	386	20.2	22.3	23.1	8	11	2.1	2.8
Occupational Group	CrfSer	133	19.5	21.8	21.1	3	2	2.3	1.5
	ElMeRe	276	15.9	22.8	21.0	19	14	6.9	5.1
	SkilTe	391	18.4	25.6	22.8	28	17	7.2	4.3
	Suppor	237	15.2	20.7	19.0	13	9	5.5	3.8
Grade	4	252	16.7	30.6	21.4	35	12	13.9	4.8
	5	769	17.4	21.2	21.3	29	30	3.8	3.9
Term of Enlistment	4	783	17.5	24.3	20.4	53	23	6.8	2.9
	6	233	15.0	20.2	22.7	12	18	5.2	7.7
Term Year	4	783	17.5	24.3	20.4	53	23	6.8	2.9
	6	233	15.0	20.2	22.7	12	18	5.2	7.7
Year of Service	6	418	17.9	26.6	22.2	36	18	8.6	4.3
	7	220	13.6	25.5	18.2	26	10	11.8	4.5
	8	295	21.0	20.3	22.0	−2	3	−.7	1.0

Table 4.12

SECOND-TERM ETS, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	840	16.3	23.6	13.1	61	−27	7.3	−3.2
	1.0	147	18.4	21.1	13.6	4	−7	2.7	−4.8
Occupational Group	CrfSer	144	15.3	22.9	11.8	11	−5	7.6	−3.5
	ElMeRe	218	15.1	22.0	12.4	15	−6	6.9	−2.8
	SkilTe	343	25.7	28.0	16.6	8	−31	2.3	−9.0
	Suppor	331	10.3	19.6	11.5	31	4	9.4	1.2
Grade	4	193	23.8	31.1	14.5	14	−18	7.3	−9.3
	5	795	15.3	21.9	13.2	52	−17	6.5	−2.1
Year of Service	6	339	22.4	27.7	13.9	18	−29	5.3	−8.6
	7	314	14.6	23.9	12.1	29	−8	9.2	−2.5
	8	228	14.5	20.2	14.5	13	0	5.7	0.0

Table 4.13

SECOND-TERM EXTENSION, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Occupational Group	CrfSer	79	6.3	13.9	15.2	6	7	7.6	8.9
	ElMeRe	207	7.7	15.5	11.1	16	7	7.7	3.4
	SkilTe	331	10.3	19.0	16.6	29	21	8.8	6.3
	Suppor	188	8.0	14.4	11.2	12	6	6.4	3.2
Term of Enlistment	4	631	8.2	16.2	13.3	50	32	7.9	5.1
	6	147	10.2	18.4	15.0	12	7	8.2	4.8
Term Year	5	397	8.6	19.6	15.6	44	28	11.1	7.1
	6	167	7.8	10.8	10.2	5	4	3.0	2.4
	7	184	10.9	16.8	14.1	11	6	6.0	3.3
Year of Service	7	266	10.2	19.5	16.2	25	16	9.4	6.0
	8	202	7.9	13.9	12.4	12	9	5.9	4.5
	9	210	10.5	17.1	14.8	14	9	6.7	4.3

Table 4.14

SECOND-TERM EXTENSION, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Occupational Group	CrfSer	68	11.8	16.2	10.3	3	−1	4.4	−1.5
	ElMeRe	114	7.0	14.0	8.8	8	2	7.0	1.8
	SkilTe	163	8.6	19.0	9.2	17	1	10.4	.6
	Suppor	189	10.6	12.7	8.5	4	−4	2.1	−2.1
Term Year	5	281	10.0	19.2	11.0	26	3	9.3	1.1
	6	107	9.3	9.3	6.5	0	−3	0.0	−2.8
Year of Service	7	111	11.7	18.0	11.7	7	0	6.3	0.0
	8	144	10.4	16.0	8.3	8	−3	5.6	−2.1
	9	143	11.9	14.7	9.1	4	−4	2.8	−2.8

predicted losses for EFMS are probably because many such airmen are calculated to end the fiscal year subject to a retirement model, which predicts much higher losses than seen in the career attrition model. The higher ALPS losses probably reflect the same reasoning in some way, although the phenomenon is much weaker in FY 84 than in FY 82. The anomaly suggests some problem exists in the YAR file with the coding of the year of service or with the evaluation code's decision of when it is appropriate to use the retirement model. The ALPS model makes the same mistake, at least in FY 82, suggesting some problem with the YAR file; but ALPS does not make as big a mistake as EFMS, implicating the evaluation code.

About 350 fewer airmen are in their 18th year of service than in their 19th year of service in both fiscal years. Looking ahead to Tables 4.21 and 4.22, which describe retirement-eligible airmen, there are some 300 airmen in their 18th year of service, compared with more than 700 in their 19th. In FY 82, both models *under*estimate losses for airmen in their 18th year of service. This may be further evidence of some misassignment of airmen in their 18th year of service to career or retirement models.

Career ETS

Tables 4.17 and 4.18 compare EFMS and ALPS for the career ETS model for FY 82 and FY 84 respectively.

Career Extension

Tables 4.19 and 4.20 compare EFMS and ALPS for the career extension model for FY 82 and FY 84 respectively.

Retirement

Tables 4.21 and 4.22 compare EFMS and ALPS for the retirement model for FY 82 and FY 84 respectively.

COMPARISON BY OCCUPATIONAL GROUPS

This section compares end-strength predictions of the EFMS middle-term disaggregate loss models with ALPS predictions by AFSC. Each of the approximately 400 AFSC groups found at the beginning of each fiscal year was used with the EFMS models to estimate how many airmen would be present at the end, and then these

Table 4.15

CAREER ATTRITION, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	7964	.8	2.2	1.7	118	74	1.5	.9
	1.0	419	.7	1.2	1.9	2	5	.5	1.2
Occupational Group	CrfSer	1006	.9	2.8	1.8	19	9	1.9	.9
	ElMcRe	2573	.7	1.9	1.6	30	21	1.2	.8
	SkilTe	2583	.7	2.2	1.9	39	33	1.5	1.3
	Suppor	2239	.8	2.3	1.6	33	16	1.5	.7
Grade	4	239	3.8	4.2	4.2	1	1	.4	.4
	5	3913	.8	1.5	1.6	25	31	.6	.8
	6	3127	.5	2.2	1.3	52	24	1.7	.8
	7	1048	.1	4.2	2.3	43	23	4.1	2.2
Term of Enlistment	3	123	.8	8.9	4.1	10	4	8.1	3.3
	4	5751	.8	2.2	1.7	81	52	1.4	.9
	5	866	.6	2.8	1.7	19	10	2.2	1.2
	6	1677	.8	1.2	1.6	6	13	.4	.8
Term Year	1	2980	.7	.9	1.4	7	20	.2	.7
	2	2643	.8	1.6	1.3	19	12	.7	.5
	3	2174	.7	4.3	2.3	78	35	3.6	1.6
	4	399	.5	4.0	3.0	14	10	3.5	2.5
	5	246	1.2	2.4	2.8	3	4	1.2	1.6
Year of Service	7	417	1.2	1.4	1.9	1	3	.2	.7
	8	633	1.6	1.4	1.4	−1	−1	−.2	−.2
	9	832	1.1	1.3	1.8	2	6	.2	.7
	10	587	.7	1.2	1.5	3	5	.5	.9
	11	810	.6	1.0	1.4	3	6	.4	.7
	12	1077	.6	.6	1.1	0	5	0.0	.5
	13	912	.9	.7	1.2	−2	3	−.2	.3
	14	585	.3	.5	1.0	1	4	.2	.7
	15	496	.8	.4	1.0	−2	1	−.4	.2
	16	713	.3	.3	1.0	0	5	0.0	.7
	17	777	.5	6.7	1.2	48	5	6.2	.6
	18	464	.4	15.1	8.4	68	37	14.7	8.0

Table 4.16

CAREER ATTRITION, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%)			PE (%)		PEPNR (%)	
			Actual	EFMS	ALPS	EFMS	ALPS	EFMS	ALPS
Bonus	0.0	8993	1.5	1.7	1.1	14	−39	.2	−.4
	1.0	486	2.1	1.0	1.6	−5	−2	−1.0	−.4
Occupational Group	CrfSer	1148	1.7	1.8	1.2	1	−6	.1	−.5
	ElMeRe	2999	1.6	1.4	1.1	−6	−13	−.2	−.4
	SkilTe	2965	1.4	1.9	1.1	13	−10	.4	−.3
	Suppor	2421	1.7	1.7	1.2	−1	−14	−.0	−.6
Grade	4	275	3.6	3.3	5.1	−1	4	−.4	1.5
	5	4359	2.2	1.1	1.4	−46	−34	−1.1	−.8
	6	3508	.9	1.7	.7	28	−7	.8	−.2
	7	1305	.2	2.8	.5	35	5	2.7	.4
	8	114	0.0	4.4	.9	5	1	4.4	.9
Term of Enlistment	3	156	.6	9.0	1.3	13	1	8.3	.6
	4	4968	1.7	1.9	1.2	9	−25	.2	−.5
	5	1125	1.3	2.1	.9	9	−5	.8	−.4
	6	3335	1.6	.8	1.2	−26	−12	−.8	−.4
Term Year	1	3327	1.4	.8	1.3	−22	−4	−.7	−.1
	2	2933	1.6	1.2	1.1	−12	−16	−.4	−.5
	3	2709	1.6	2.9	1.1	34	−15	1.3	−.6
	4	419	2.1	3.6	1.0	6	−5	1.4	−1.2
	5	211	1.9	2.4	.9	1	−2	.5	−.9
Year of Service	6	182	2.7	1.1	2.7	−3	0	−1.6	0.0
	7	496	2.8	1.0	2.0	−9	−4	−1.8	−.8
	8	706	2.1	1.0	1.6	−8	−4	−1.1	−.6
	9	996	3.1	1.0	1.5	−21	−16	−2.1	−1.6
	10	840	2.0	.7	1.3	−11	−6	−1.3	−.7
	11	992	1.4	.7	1.0	−7	−4	−.7	−.4
	12	831	1.2	.5	1.0	−6	−2	−.7	−.2
	13	866	1.0	.5	.9	−5	−1	−.6	−.1
	14	931	1.2	.3	.8	−8	−4	−.9	−.4
	15	683	.7	.3	.7	−3	0	−.4	0.0
	16	783	.5	.3	.8	−2	2	−.3	.3
	17	779	1.3	6.2	.8	38	−4	4.9	−.5
	18	431	.9	13.2	1.2	53	1	12.3	.2

Table 4.17

CAREER ETS, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Bonus	0.0	1526	2.9	3.8	5.7	13	42	.9	2.8
	1.0	124	6.5	4.8	6.5	−2	0	−1.6	0.0
Occupational Group	CrfSer	234	3.0	4.3	6.8	3	9	1.3	3.8
	ElMeRe	489	2.5	2.9	5.3	2	14	.4	2.9
	SkilTe	475	3.6	5.1	6.5	7	14	1.5	2.9
	Suppor	461	4.1	3.3	5.2	−4	5	−.9	1.1
Grade	5	721	5.0	6.0	6.9	7	14	1.0	1.9
	6	714	2.1	2.2	4.5	1	17	.1	2.4
	7	198	0.0	2.5	6.1	5	12	2.5	6.1
Term of Enlistment	4	1414	3.1	3.7	5.7	9	36	.6	2.5
	6	172	4.1	3.5	5.2	−1	2	−.6	1.2
Term Year	4	1414	3.1	3.7	5.7	9	36	.6	2.5
	6	172	4.1	3.5	5.2	−1	2	−.6	1.2
Year of Service	10	412	5.3	5.3	6.6	0	5	0.0	1.2
	11	182	6.0	3.8	6.0	−4	0	−2.2	0.0
	12	—							
	13	156	1.9	1.9	4.5	0	4	0.0	2.6
	14	265	.4	1.1	3.0	2	7	.8	2.6
	15	237	.8	.8	3.4	0	6	0.0	2.5
	16	—							

NOTE: There were too few airmen at 12 and 16 years of service to make reliable estimates.

estimates were compared with those of ALPS. The findings are summarized in Table 4.23.

The EFMS model appears to do better than ALPS in FY 82, but the differences are not as great in FY 84, probably because economic factors did not change so much in FY 84; and data from FY 82 were used to estimate the EFMS model, but data from FY 84 were not.

Table 4.23 treats each AFSC as equally important, but some AFSCs have thousands of airmen, and others have only a few. Table 4.24 compares the two models in

Table 4.18

CAREER ETS, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%)			PE (%)		PEPNR (%)	
			Actual	EFMS	ALPS	EFMS	ALPS	EFMS	ALPS
Occupational Group	CrfSer	207	2.4	2.4	2.9	0	1	0.0	.5
	ElMeRe	482	2.3	2.7	3.1	2	4	.4	.8
	SkilTe	435	4.4	3.4	3.0	−4	−6	−.9	−1.4
	Suppor	399	2.3	2.5	2.8	1	2	.3	.5
Grade	5	544	4.0	4.6	3.9	3	−1	.6	−.2
	6	727	1.5	1.7	2.5	1	7	.1	1.0
	7	224	.9	1.8	2.2	2	3	.9	1.3
Term of Enlistment	4	1291	2.7	2.8	3.0	1	4	.1	.3
	6	172	5.2	2.3	2.9	−5	−4	−2.9	−2.3
Term Year	4	1291	2.7	2.8	3.0	1	4	.1	.3
	6	172	5.2	2.3	2.9	−5	−4	−2.9	−2.3
Year of Service	10	207	5.3	4.8	3.9	−1	−3	−.5	−1.4
	11	182	3.8	3.3	3.3	−1	−1	−.5	−.5
	12	132	4.5	3.0	3.0	−2	−2	−1.5	−1.5
	13	156	2.6	1.3	2.6	−2	0	−1.3	0.0
	14	343	1.5	1.2	2.9	−1	5	−.3	1.5
	15	280	1.4	.7	2.5	−2	3	−.7	1.1
	16	100	2.0	1.0	3.0	−1	1	−1.0	1.0

Table 4.19

CAREER EXTENSION, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%)			PE (%)		PEPNR (%)	
			Actual	EFMS	ALPS	EFMS	ALPS	EFMS	ALPS
Occupational Group	CrfSer	62	1.6	9.7	3.2	5	1	8.1	1.6
	ElMeRe	169	2.4	4.1	5.3	3	5	1.8	3.0
	SkilTe	229	3.5	6.1	5.2	6	4	2.6	1.7
	Suppor	175	1.7	5.1	4.0	6	4	3.4	2.3
Grade	5	229	2.6	5.2	6.1	6	8	2.6	3.5
	6	305	3.0	5.6	3.6	8	2	2.6	.7
Term Year	5	351	1.7	5.7	4.6	14	10	4.0	2.8
	6	165	3.6	4.8	4.2	2	1	1.2	.6
Year of Service	11	156	3.2	5.1	5.1	3	3	1.9	1.9
	12	117	1.7	4.3	4.3	3	3	2.6	2.6

Table 4.20

CAREER EXTENSION, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Occupational Group	CrfSer	59	5.1	8.5	1.7	2	–2	3.4	–3.4
	ElMcRe	135	2.2	3.7	2.2	2	0	1.5	0.0
	SkilTe	122	5.7	6.6	2.5	1	–4	.8	–3.3
	Suppor	132	.8	4.5	2.3	5	2	3.8	1.5
Grade	5	121	6.6	5.0	3.3	–2	–4	–1.7	–3.3
	6	248	1.6	5.6	1.6	10	0	4.0	0.0
Term Year	5	237	1.7	5.5	2.1	9	1	3.8	.4
	6	103	4.9	3.9	1.9	–1	–3	–1.0	–2.9

a different way and shows how the two models compare when differences in AFSC sizes are taken into account.

For each AFSC, the absolute value of each model's prediction error was calculated to see whether the EFMS prediction was better (absolute value of error closer to zero), the same, or worse than ALPS. Table 4.24, reading down the first column in each fiscal year panel under AFSC, shows the percent of all AFSCs in which EFMS did better, the same, or worse than ALPS respectively. In each fiscal year, ALPS performed strictly better than EFMS on less than a quarter of the AFSCs.

In the second column, the comparison was weighted by the number of airmen in the associated AFSC. A number in an Airmen column may be thought of as the probability that an "average" airman will belong to an AFSC where EFMS does better, the same, or worse than ALPS, respectively. As can be seen, in FY 82 only 10 percent of the force belonged to AFSCs in which ALPS did better. The percent where EFMS is the same as ALPS is considerably smaller in the weighted column than in the unweighted column largely because it is easier for the two models to agree on the many small AFSCs containing only one or two sampled airmen.

It is hard to compare the two models on small AFSCs. These smaller AFSCs were eliminated from subsequent analysis by sorting them from largest to smallest; and the cumulative number of airmen obtained was calculated from larger to smaller. When the accumulated sum was 90 percent of the sample of airmen, all smaller ones were dropped. So the following observations apply to approximately 90 percent of the Air Force.

Table 4.21

RETIREMENT, FY 82

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Occupational Group	CrfSer	256	24.6	34.8	28.1	26	9	10.2	3.5
	ElMeRe	744	26.2	34.8	28.9	64	20	8.6	2.7
	SkilTe	1026	27.7	34.1	29.6	66	20	6.4	1.9
	Suppor	894	26.1	32.6	29.3	58	29	6.5	3.2
Grade	6	533	35.3	42.8	35.8	40	3	7.5	.6
	7	1420	26.8	33.5	29.4	96	38	6.8	2.7
	8	623	17.3	26.6	21.8	58	28	9.3	4.5
	9	314	25.2	30.6	26.1	17	3	5.4	1.0
Term of Enlistment	2	168	29.2	52.4	35.7	39	11	23.2	6.5
	3	759	25.6	36.4	29.4	82	29	10.8	3.8
	4	1638	27.5	31.7	29.5	68	33	4.2	2.0
	5	231	24.2	32.9	28.6	20	10	8.7	4.3
	6	141	24.1	25.5	19.9	2	–6	1.4	–4.3
Term Year	1	508	13.2	26.8	15.0	69	9	13.6	1.8
	2	537	17.5	30.7	22.3	71	26	13.2	4.8
	3	419	26.3	35.1	27.7	37	6	8.8	1.4
	4	758	32.8	38.4	34.8	42	15	5.5	2.0
	5	436	36.0	30.5	39.2	–24	14	–5.5	3.2
	6	165	37.0	41.2	39.4	7	4	4.2	2.4
Year of Service	18	327	41.3	37.6	35.8	–12	–18	–3.7	–5.5
	19	838	31.7	36.8	34.5	42	23	5.0	2.7
	20	511	18.4	26.8	23.1	43	24	8.4	4.7
	21	315	18.7	28.6	23.5	31	15	9.8	4.8
	22	209	23.4	25.8	25.4	5	4	2.4	1.9
	23	172	16.9	22.7	20.3	10	6	5.8	3.5
	24	172	21.5	36.6	25.0	26	6	15.1	3.5
	25	155	30.3	43.2	30.3	20	0	12.9	0.0
	26	124	19.4	45.2	27.4	32	10	25.8	8.1

Table 4.22

RETIREMENT, FY 84

Stratification Factor	Level	Airmen at Risk	Loss Rate (%) Actual	Loss Rate (%) EFMS	Loss Rate (%) ALPS	PE (%) EFMS	PE (%) ALPS	PEPNR (%) EFMS	PEPNR (%) ALPS
Occupational Group	CrfSer	294	31.0	33.0	24.8	6	−18	2.0	−6.1
	ElMcRe	869	32.5	32.8	25.5	3	−60	.3	−6.9
	SkilTe	1093	34.5	31.7	26.4	−31	−88	−2.8	−8.1
	Suppor	799	27.9	28.5	22.5	5	−43	.6	−5.4
Grade	6	494	44.7	43.9	34.2	−4	−52	−.8	−11
	7	1433	32.2	31.0	25.0	−18	−104	−1.3	−7.3
	8	720	24.4	23.2	18.9	−9	−40	−1.3	−5.6
	9	399	23.6	28.1	19.8	18	−15	4.5	−3.8
Term of Enlistment	2	216	38.9	44.9	36.6	13	−5	6.0	−2.3
	3	761	32.2	33.8	26.0	12	−47	1.6	−6.2
	4	1624	30.9	29.1	23.3	−29	−124	−1.8	−7.6
	5	287	37.6	30.3	26.8	−21	−31	−7.3	−11
	6	197	22.3	25.9	20.8	7	−3	3.6	−1.5
Term Year	1	485	15.5	21.6	10.5	30	−24	6.2	−4.9
	2	577	21.1	26.0	16.5	28	−27	4.9	−4.7
	3	581	29.1	34.1	23.8	29	−31	5.0	−5.3
	4	734	42.8	35.8	32.6	−51	−75	−6.9	−10
	5	363	43.0	30.3	34.4	−46	−31	−12.7	−8.5
	6	190	36.8	36.8	33.2	0	−7	0.0	−3.7
Year of Service	18	272	43.8	34.6	25.0	−25	−51	−9.2	−19
	19	743	45.0	38.0	35.3	−52	−72	−7.0	−9.7
	20	509	26.7	23.8	20.4	−15	−32	−2.9	−6.3
	21	468	24.6	27.8	19.0	15	−26	3.2	−5.6
	22	308	25.0	25.6	19.8	2	−16	.6	−5.2
	23	211	21.3	17.5	20.4	−8	−2	−3.8	−.9
	24	144	13.9	29.9	13.2	23	−1	16.0	−.7
	25	123	22.0	39.8	23.6	22	2	17.9	1.6
	26	103	26.2	38.8	21.4	13	−5	12.6	−4.9

Table 4.23

COMPARISONS OVER ALL AFSCs

	FY 82		FY 84	
Statistic	EFMS	ALPS	EFMS	ALPS
Average Absolute Error	3.0	4.2	2.1	2.0
Root Mean Square Error	8.6	12.9	4.9	4.3

Table 4.24

PERCENT OF AFSCs AND AIRMEN WHERE EFMS DOES BETTER

	FY 82		FY 84	
AFSCs where:	AFSC	Airmen	AFSC	Airmen
EFMS better than ALPS	32	75	27	43
EFMS same as ALPS	41	10	45	14
EFMS worse than ALPS	27	19	28	43

To standardize predictions across AFSCs the prediction error (predicted end strength minus actual) of each model was divided by the number of airmen at risk. Figures 5 and 6 plot these estimates, restricted to the "larger" AFSCs, for each model. For clarity, the sample was sorted by ascending values of the ALPS error.

In Figs. 5 or 6, a perfect model would have zero error, and its graph would coincide with the axis line running across the middle of each display. The closer the graph of a real model lies to this axis, the better it is. It is clear that in FY 82, the EFMS model performance is superior to that of ALPS. In FY 84, the EFMS model appears to do better over those AFSCs where the ALPS model underpredicts losses, but it tends to do worse than the EFMS model over those AFSCs where the ALPS model overpredicts losses.

Finally, each of the samples of "large" AFSCs was sorted by size, largest to smallest and then the cumulative absolute error calculated for each model. This cumulative sum was plotted against the fraction of the force covered by the sum. These plots are shown in Figs. 7 and 8. A perfect model would have absolute errors equal to zero in each AFSC, and so its curve would lie flat along the x-axis. The closer the graph of a real model lies to this axis, the better it is. As can be seen, in FY 82 the two curves diverge sharply, indicating a superior performance of the EFMS model across many AFSCs. In FY 84, the EFMS shows a slightly superior performance for the larger AFSCs.

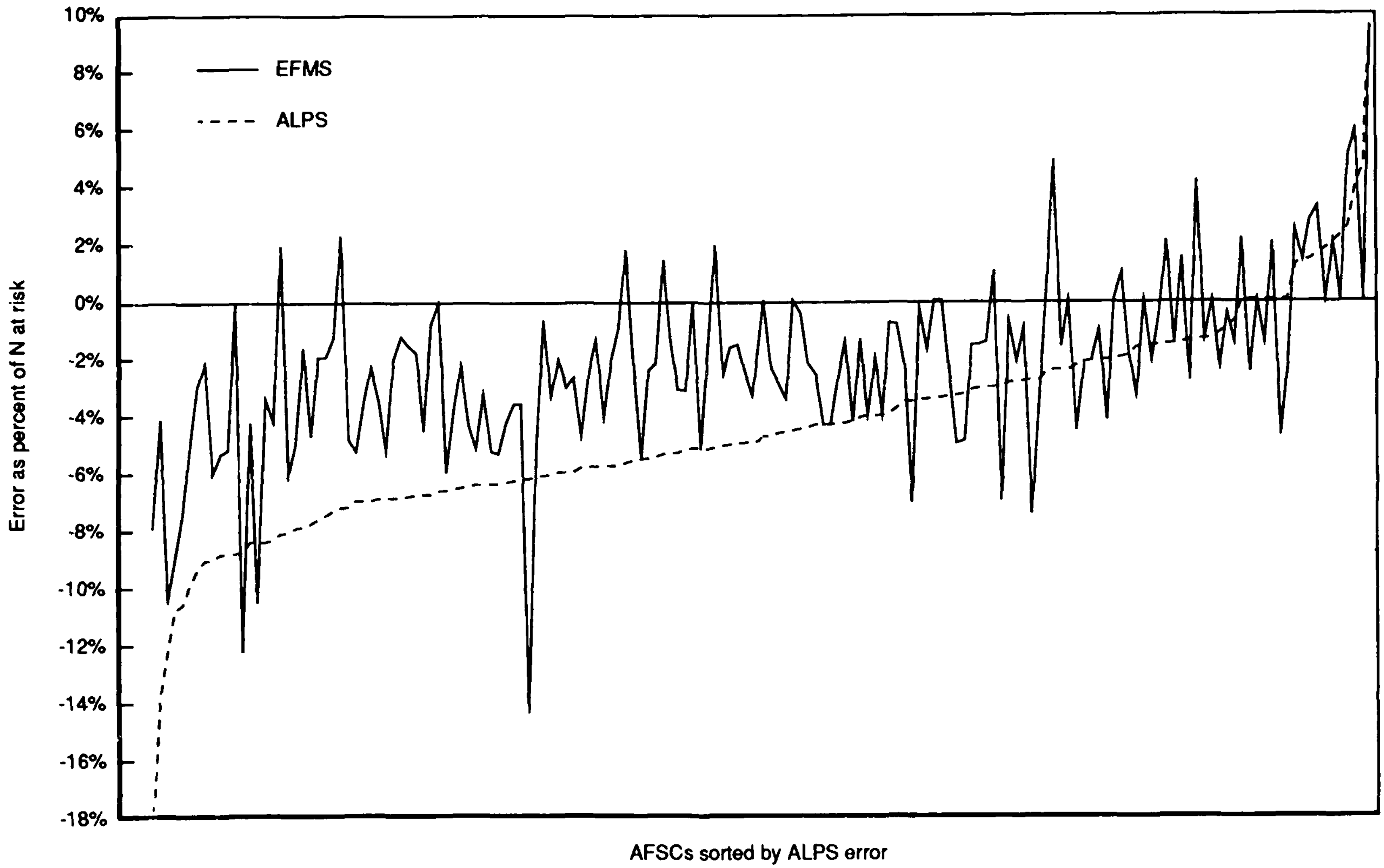

Fig. 5—Comparing Error as a Percent of Airmen at Risk, FY 82

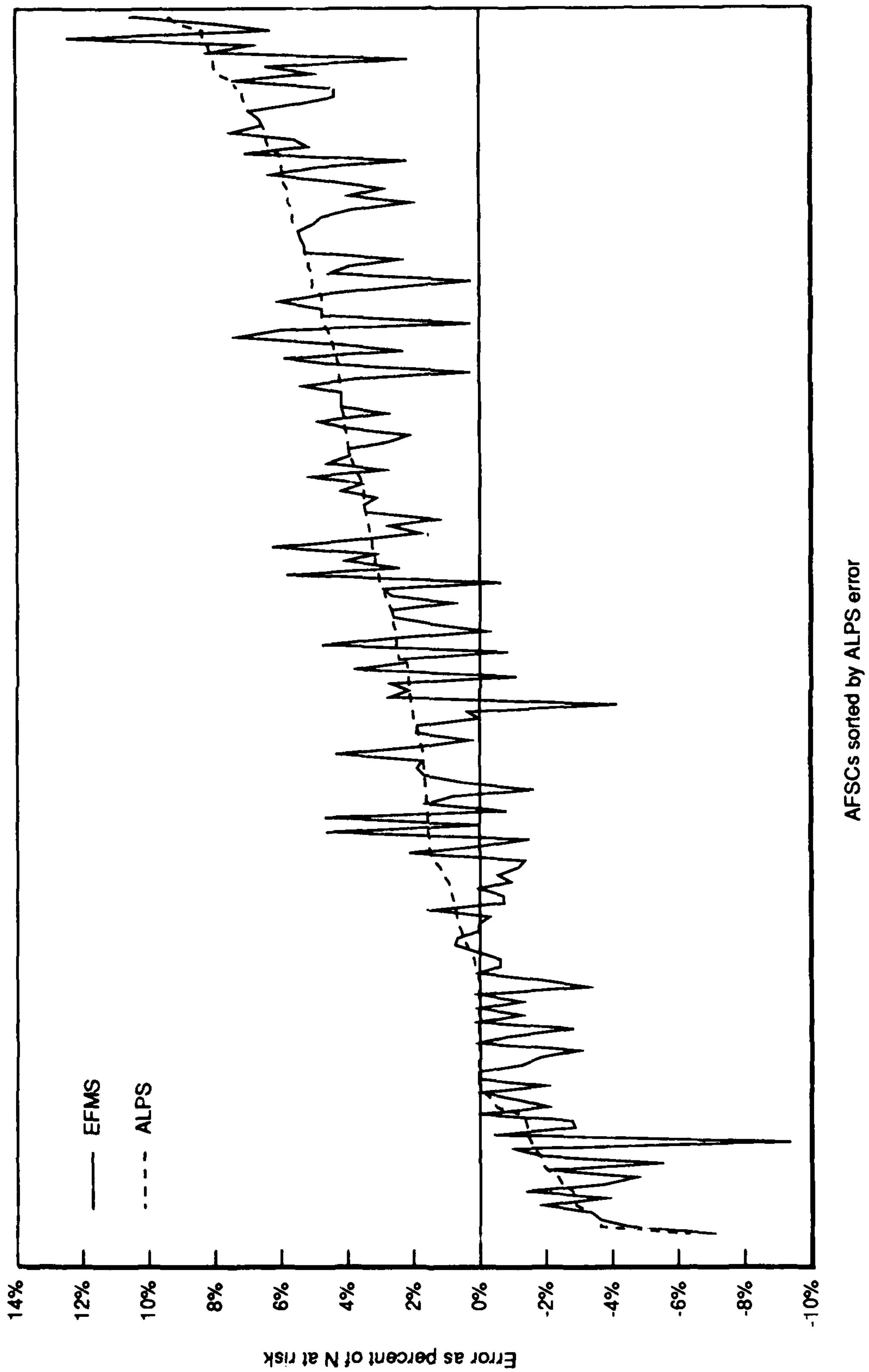

Fig. 6—Comparing Error as a Percent of Airmen at Risk, FY 84

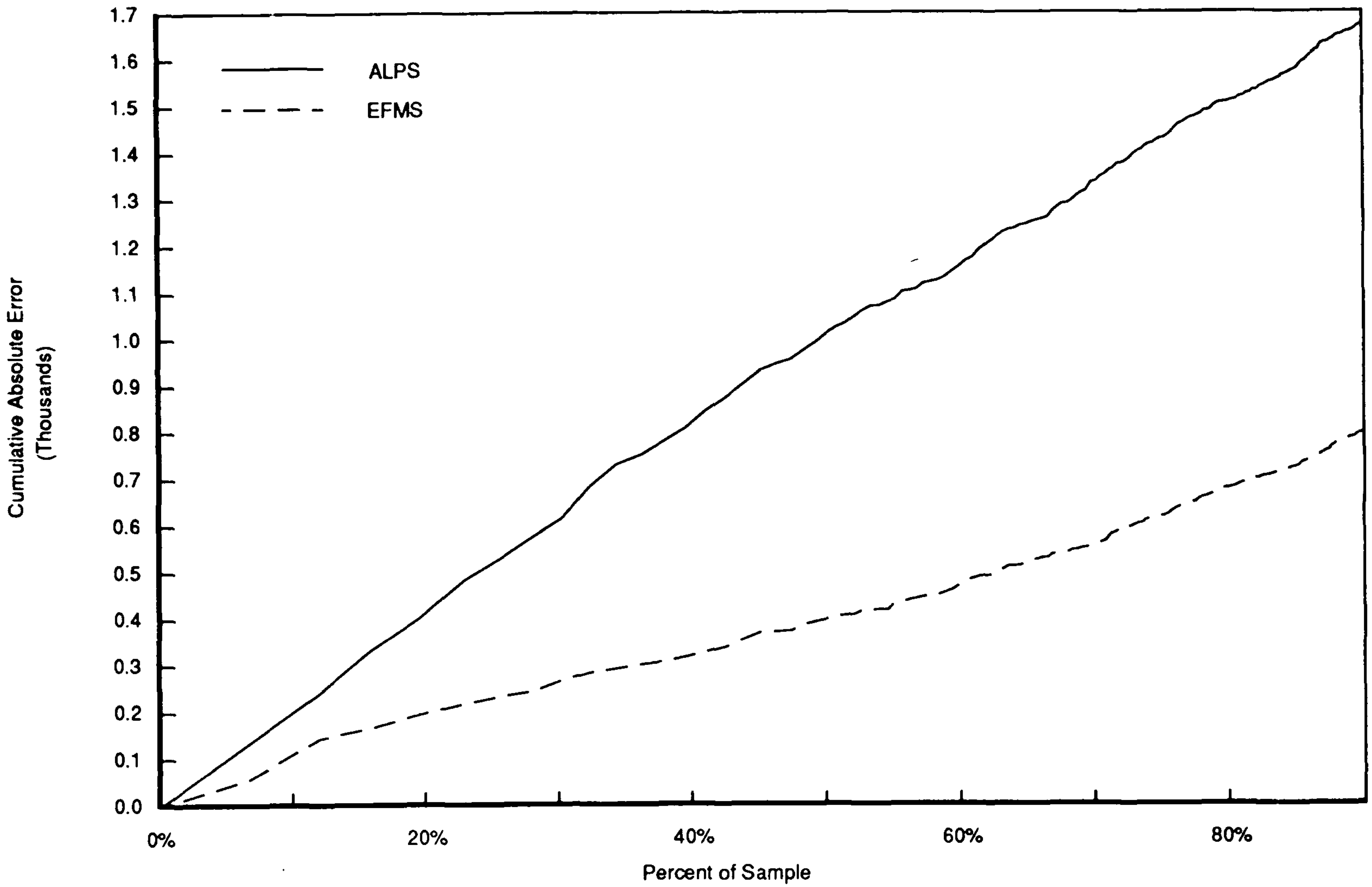

Fig. 7—Comparing Cumulative Absolute Errors, FY 82

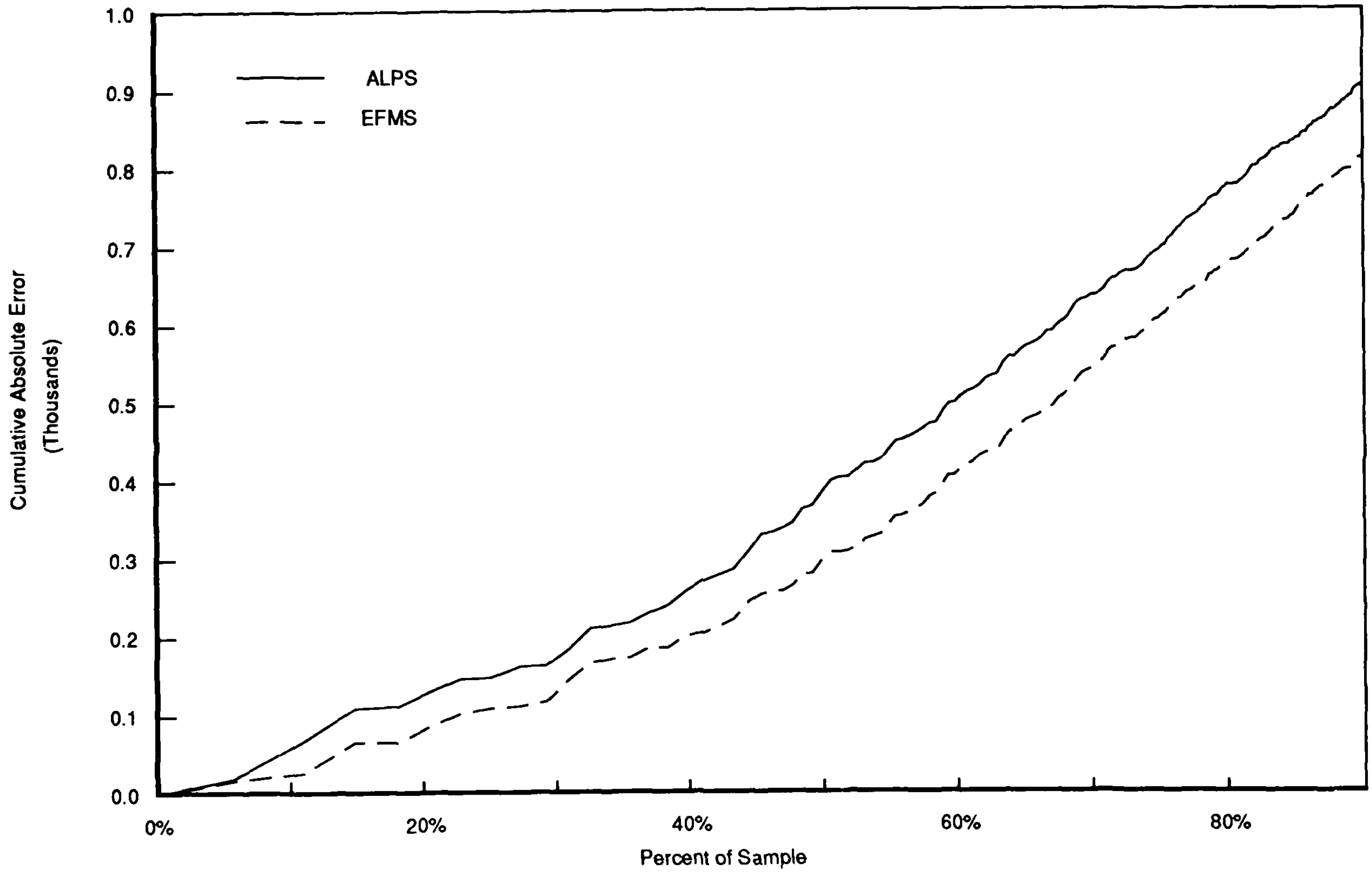

Fig. 8—Comparing Cumulative Absolute Errors, FY 84

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